



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification<sup>4</sup> :  A01N 43/66, 43/707, 43/54  A01N 43/58, 43/72, 37/32  C07D 251/26, 251/38, 251/44  C07D 251/20, 401/12, 413/12  C07D 251/06, 251/30, 251/50  C07D 417/12, 253/06, 237/16  C07D 239/34, 237/14, 207/456  C07D 409/06, 207/50, 207/40  C07D 405/06, 417/04, 209/02  C07D 207/448, C07F 9/65</p>	A2	<p>(11) International Publication Number:      <b>WO 87/ 04321</b></p> <p>(43) International Publication Date:      30 July 1987 (30.07.87)</p>
<p>(21) International Application Number:      PCT/US87/00240</p> <p>(22) International Filing Date:      23 January 1987 (23.01.87)</p> <p>(31) Priority Application Numbers:      824,389  939,416</p> <p>(32) Priority Dates:      23 January 1986 (23.01.86)  15 December 1986 (15.12.86)</p> <p>(33) Priority Country:      US</p> <p>(71) Applicant: UNION CARBIDE AGRICULTURAL PRO-  DUCTS COMPANY, INC. [US/US]; 39 Old Ridgebury  Road, Danbury, CT 06817 (US).</p> <p>(72) Inventors: MANNING, David, Treadway ; 102 Summerwinds  Drive, Cary, NC 27511 (US). CAPPY, James, Joseph ; 4905  Kaplan Drive, Raleigh, NC 27606 (US). COOKE, Anson,  Richard ; 1210 Huntsman Drive, Durham, NC 27713 (US).  SHEADS, Richard, Eric ; 1727 East Cornwallis Road,</p>	<p>Durham, NC 27713 (US). WU, Tai-Teh ; 115 Summerlin  Drive, Chapel Hill, NC 27514 (US). LOPES, Anibal ; 6813-  M Woodbend Drive, Raleigh, NC 27609 (US). PHILLIPS,  Jennifer, Lyn ; Rural Route 3 - Box 220B, Apex, NC 27502  (US). OUTCALT, Russell, James ; 107 Coatbridge Circle,  Cary, NC 27511 (US).</p> <p>(74) Agent: COON, Gerald, L.; Union Carbide Agricultural Pro-  ducts Company, Inc. , Law Department - E134, 39 Old Rid-  gebury Road, Danbury, CT 06817 (US).</p> <p>(81) Designated States: AT (European patent), AU, BE (European  patent), BR, CH (European patent), DE (European patent),  DK, FI, FR (European patent), GB (European patent), HU,  IT (European patent), JP, KR, LK, LU (European patent),  MW, NL (European patent), NO, RO, SD, SE (European  patent), SU.</p> <p><b>Published</b>  <i>Without international search report and to be republished up-  on receipt of that report.</i></p>	
<p>(54) Title: USE OF HETEROCYCLIC NITROGEN-CONTAINING COMPOUNDS FOR REDUCING MOISTURE  LOSS FROM PLANTS AND INCREASING CROP YIELD</p> <p>(57) Abstract</p> <p>A method for reducing transpirational moisture loss from plants and increasing crop yield by applying to the plant  surface or crop an effective amount of a heterocyclic nitrogen-containing compound. This invention also relates to novel  heterocyclic nitrogen-containing compounds and processes for the preparation thereof.</p>		

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Use of Heterocyclic Nitrogen-Containing  
Compounds for Reducing Moisture Loss from  
Plants and Increasing Crop Yield

Brief Summary of the Invention

Technical Field

This invention relates to the use of heterocyclic nitrogen-containing compounds for reducing transpirational moisture loss from plants and also for increasing crop yield. This invention further relates to novel heterocyclic nitrogen-containing compounds and processes for the preparation thereof.

Background of the Invention

Transpiration is a well known physiological process involving the passage of water in the form of a vapor through living tissues. In plant transpiration, the water vapor passes through plant stomatal openings into the atmosphere, thus facilitating the absorption and translocation of aqueous nutrients by plant root systems. The stomatal openings also permit necessary gaseous interchange between plant tissues and the external air. It is believed that only about one percent of the total water absorbed by plant roots is used for plant growth, the remainder being released through plant stomatal openings into the atmosphere by transpiration.

It has been determined that only a very low rate of transpiration in plants is required for necessary nutrient transport and normal plant growth. Although complete cessation of

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transpiration would most probably be detrimental or even fatal to plants, it is believed that a decrease in plant transpiration rate up to about 40 to 50 percent would not be detrimental to plants. See, for example, U.S. Patent No. 4,094,845.

The reduction of transpiration water loss from plants is important for several reasons; in particular, for decreasing requirements for irrigation water especially in dry climate regions, for protecting plants from wilting or other damage during transplantation or shipment or during severe cold weather, and for alleviating water stress in certain types of environments. Water stress as used herein occurs when the transpiration rate exceeds the rate of water uptake by the plant. Water stress appears as a decrease in plant water potential and turgor and can result in wilting or other forms of damage or even plant death.

Various methods have been developed for decreasing transpirational moisture loss from plants. Such methods are described, for example, in U.S. Patent Nos. 4,094,845, 4,397,681, 3,890,158, 3,847,641, 3,826,671, 3,676,102, 3,539,373, 3,339,990, 3,199,944, and also EP 73,760-B. Various materials described in the patent literature which have been used to reduce water loss from plants by transpiration include, for example, carboxylated hydrophilic acrylic polymers, wax emulsions, animal tallow, alkenyl succinic acids, long chain esters of lower organic acids, polyisocyanates, liquid polyterpenes, benzyl alkyl ammonium salts, and the like. However, even though these materials may



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decrease transpirational moisture loss from plants, many of these materials have a detrimental effect on other plant processes such as photosynthesis, respiration, cell division, and the like.

The use of 2-chloro-4-ethylamino-6-isopropylamino-s-triazine (atrazine) for reducing transpirational water loss from plants has also been reported in the literature. See, for example, G. D. Wills et al., Weeds 11: 253-255 (1963) and also James C. Graham et al., Weed Science 16: 389-392 (1968). However, inhibition of plant photosynthetic light-requiring reactions, e.g., photosynthetic electron transport, and plant phytotoxicity are associated with the use of atrazine as an antitranspirant compound.

Accordingly, it is an object of this invention to provide a method for the use of certain heterocyclic nitrogen-containing compounds to reduce transpirational moisture loss from plants, and thereby provide for more efficient soil moisture utilization. It is another object of this invention to provide a method for the use of certain heterocyclic nitrogen-containing compounds to increase crop yields. It is yet another object of this invention to provide novel heterocyclic nitrogen-containing compounds and processes for the preparation thereof. These and other objects will readily become apparent to those skilled in the art in light of the teachings herein set forth.

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Disclosure of the Invention

This invention relates to a method for reducing moisture loss from plants which comprises applying to the plant surface an effective amount, sufficient to reduce moisture loss from the plant surface without substantially inhibiting plant photosynthetic electron transport, of a compound having the formula:



wherein  $R_1$ ,  $R_2$  and X are as defined hereinafter.

This invention also relates to a method of increasing crop yield which comprises applying to the crop an effective amount, sufficient to increase crop yield without substantially inhibiting plant photosynthetic electron transport, of a compound having the formula:



wherein  $R_1$ ,  $R_2$  and X are as defined hereinafter.

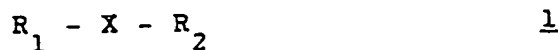
This invention further relates to novel heterocyclic nitrogen-containing compounds and also to processes for the preparation of said compounds.

Detailed Description

As indicated above, this invention relates to a method of reducing moisture loss from plants and increasing crop yields by the use of certain heterocyclic nitrogen-containing compounds. More particularly, this invention involves a method for reducing transpirational moisture loss from plants

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and increasing crop yield which comprises applying to the plant surface or crop an effective amount, sufficient to reduce moisture loss from the plant surface or to increase crop yield without substantially inhibiting plant photosynthetic electron transport, of a compound having the formula:



wherein:

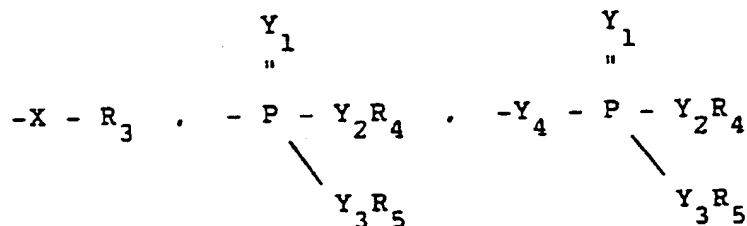
$R_1$  is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents (Z) are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in

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which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy.

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polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,  
-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>.



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R<sub>1</sub> is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents

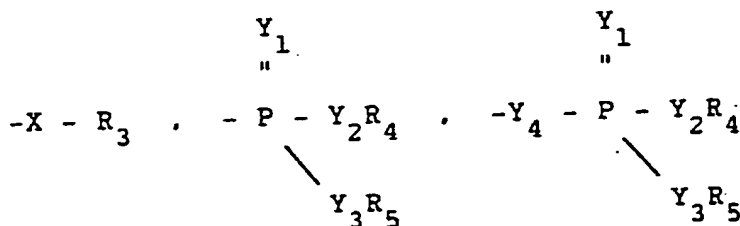
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(Z) are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted

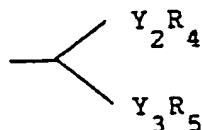
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aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
 or substituted arylhydrazonomethyl, a hydroxy group  
 condensed with a mono-, di- or polysaccharide,  
 haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
 aryloxy, aralkoxy, arylthio, aralkylthio,  
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyposphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,  
 $-X = X$ ,  $-X = R_3$ ,  $= X-R_3$ .

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or



X is a covalent single bond or double bond, a substituted or unsubstituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents (Z) are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts.



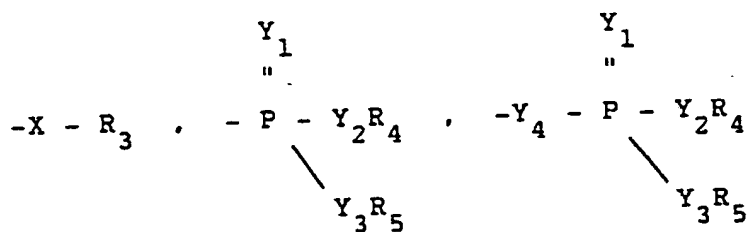
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formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl,

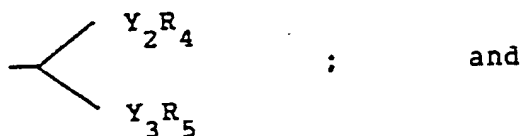
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carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium.

$-X, = X, -X = R_3, = X-R_3,$



or



$R_2$  is a substituted or unsubstituted,  
 heterocyclic ring system having at least one

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nitrogen atom which is selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents (Z) are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl;

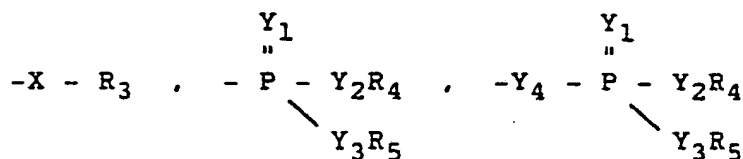
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alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl, dialkoxyphosphino, hydroxyamino, alkoxyamino, aryloxyamino, aryloxyimino, oxo, thiono,

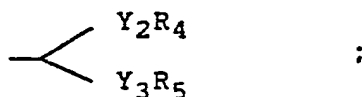
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alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



wherein:

$R_3$  is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents (Z) are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, arylalkylsilyloxy, triarylalkylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl,

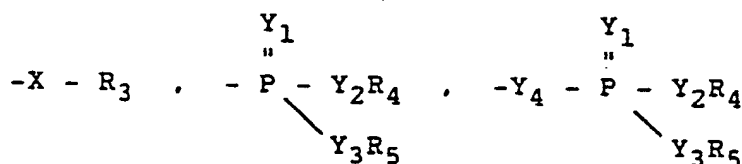
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nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl,

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dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



$R_3$  is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents (Z) are the same or different and are one or more hydrogen, halogen, alkylcarbonyl,

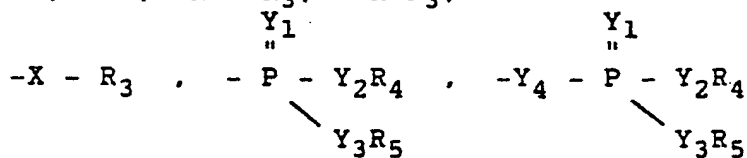
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alkylcarbonylalkyl, alkoxycarbonylalkyl,  
alkoxycarbonylalkylthio, polyhaloalkenylthio,  
thiocyano, propargylthio, hydroxyimino, alkoxyimino,  
trialkylsilyloxy, aryldialkylsilyloxy,  
triarylsilyloxy, formamidino, alkylsulfamido,  
dialkylsulfamido, alkoxysulfonyl,  
polyhaloalkoxysulfonyl, hydroxy, amino,  
aminocarbonyl, alkylaminocarbonyl,  
dialkylaminocarbonyl, aminothiocarbonyl,  
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
nitro, cyano, hydroxycarbonyl and derivative salts,  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group



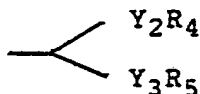
- 19 -

condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyle, haloacyl, polyhaloacyl, aryloxy-carbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroyle-amino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, aryle-amino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$$-X, = X, -X = R_3, = X-R_3,$$


or

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$Y_1$  and  $Y_4$  are independently oxygen or sulfur;

$Y_2$  and  $Y_3$  are independently oxygen, sulfur, amino or a covalent bond; and

$R_4$  and  $R_5$  are independently hydrogen or substituted or unsubstituted alkyl, polyhaloalkyl, phenyl or benzyl in which the permissible substituents (Z) are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino,

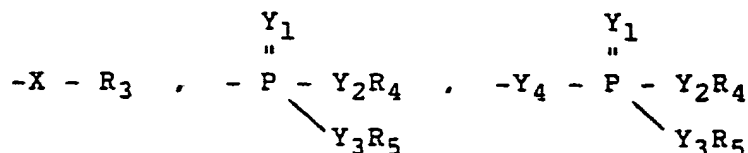
- 21 -

polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino,

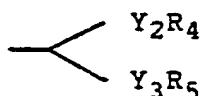
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aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X. = X, -X = R_3, = X-R_3,$



or

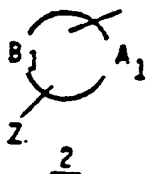


The alkyl-containing moieties above may contain from about 1 to about 100 carbon atoms or greater, preferably from about 1 to about 30 carbon atoms, and more preferably from about 1 to about 20 carbon atoms. The polysaccharide moiety may contain up to about 50 carbon atoms. It is appreciated that all compounds encompassed within formula 1 are compounds having no unfilled bonding positions. It is further appreciated that in order for a substituent to be permissible for the compounds encompassed within formula 1, the valence of the substituent must be appropriate with the bonding capability of the particular carbon atom or heteroatom.

Monocyclic ring systems encompassed by  $R_1$  and  $R_3$  in formula 1 may be represented by

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generalized formula 2 as follows:



wherein  $B_1$  represents a saturated or unsaturated carbon atom and  $A_1$  represents a ring-forming chain of atoms which together with  $B_1$  forms a cyclic system containing from 0 to 4 double bonds or from 0 to 2 triple bonds.  $A_1$  may contain entirely from 2 to 12 carbon atoms, may contain a combination of from 1 to 11 carbon atoms and from 1 to 4 heteroatoms which may be selected independently from N, O, S, P or other heteroatoms, or may contain 4 ring-forming heteroatoms alone.

Monocyclic ring systems encompassed by  $R_2$  in formula 1 may include any monocyclic ring system of  $R_1$  and  $R_3$  having at least one nitrogen atom.

Ring-forming heteroatoms may in some cases bear oxygen atoms as in aromatic and aliphatic N-oxides and ring systems containing the sulfinyl, sulfonyl, selenoxide and phosphine oxide moieties.

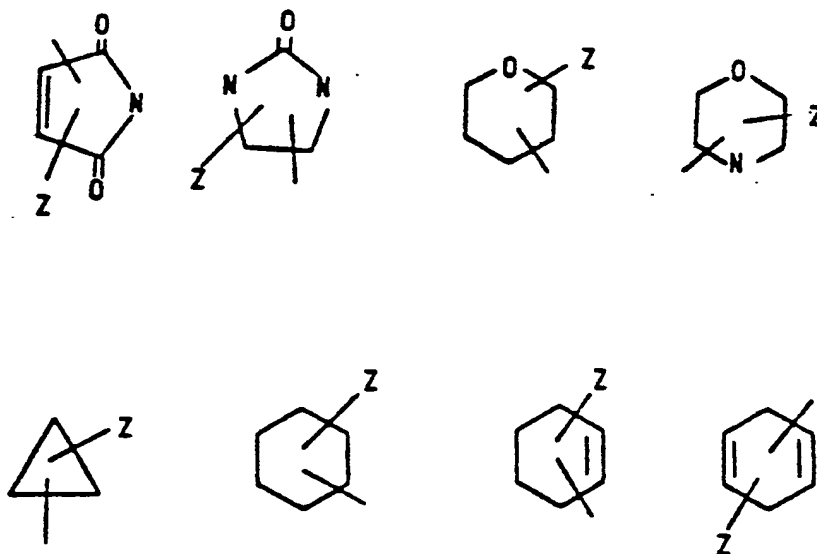
Selected carbon atoms contained in cycles formed by  $B_1$  and  $A_1$  containing more than 3 ring-forming atoms may bear carbonyl, thiocarbonyl, substituted or unsubstituted imino groups or substituted or unsubstituted methyldene groups.

The group designated as Z represents one or more substituents selected independently from among the group of substituents defined for Z herein. When the cycle formed by  $B_1$  and  $A_1$  contains

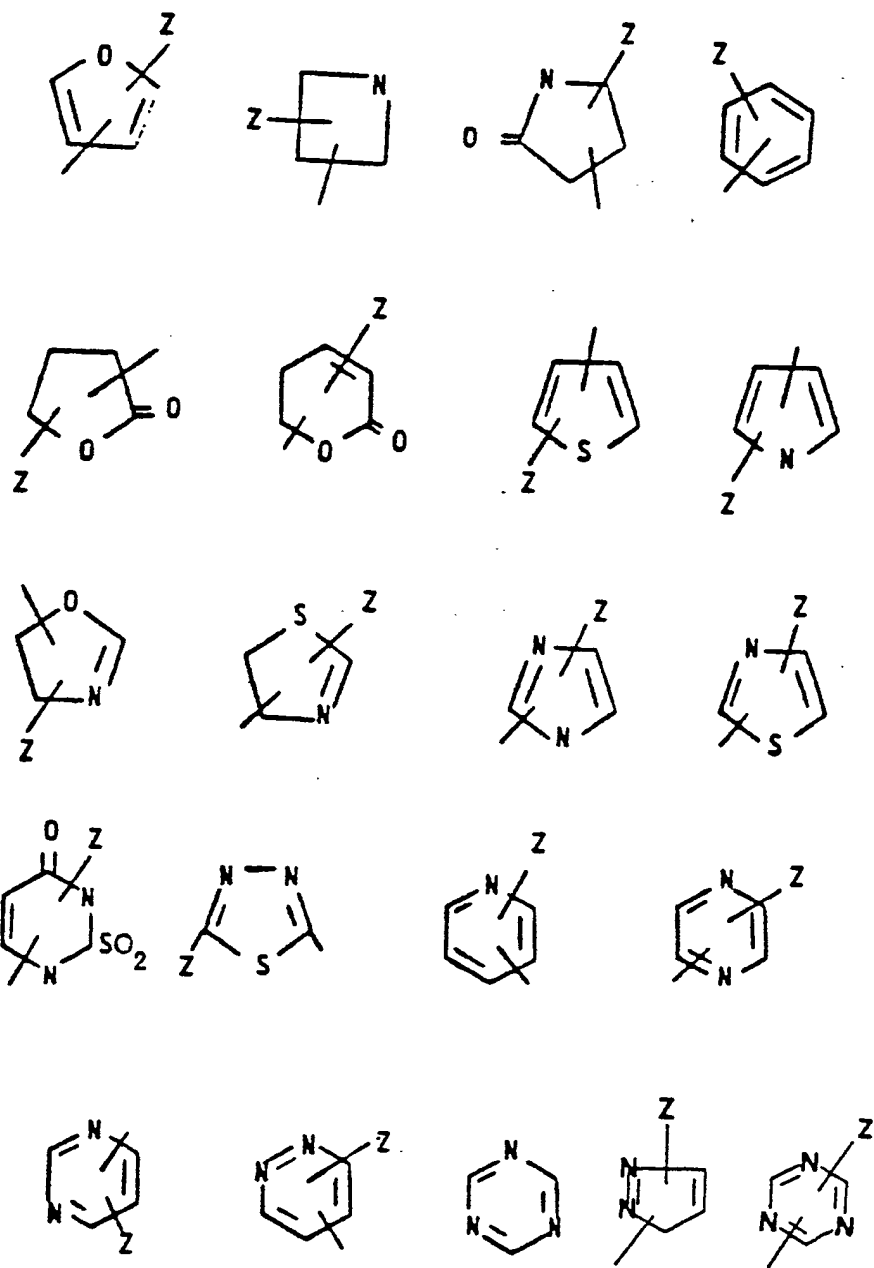
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fewer than 4 ring forming members, it should be a saturated carbocycle, i.e. cyclopropyl. When the cycle formed by  $B_1$  and  $A_1$  contains fewer than 5 ring-forming members, it should contain no more than 1 heteroatom.

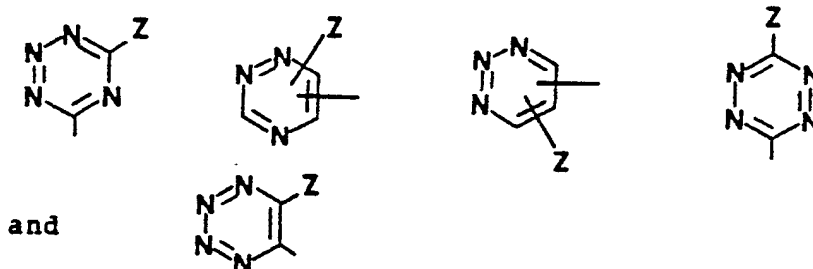
Illustrative monocyclic ring structures which are encompassed by  $R_1$  and  $R_3$  in formula 1 include the following:



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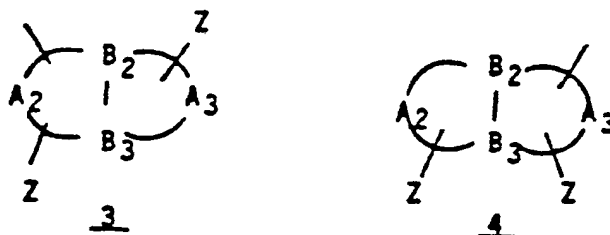


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wherein Z is as defined herein.

Bicyclic ring systems encompassed by  $R_1$  and  $R_3$  in formula 1 may be represented by generalized formulae 3 and 4 as follows:



wherein  $B_2$  and  $B_3$  may be independently a saturated or unsaturated carbon atom or a saturated nitrogen atom,  $A_2$  and  $A_3$  independently represent the ring-forming chains of atoms described below and Z represents one or more substituents selected independently from among the group of substituents



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defined for Z herein. Combinations of  $A_2$  and  $A_3$  may contain in combination with  $B_2$  or  $B_3$  from 0 to 5 double bonds.  $A_2$  and  $A_3$ , independent of  $B_2$  and  $B_3$ , may contain entirely from 1 to 11 carbon atoms, may contain a combination of 1 to 3 heteroatoms which may be selected independently from among N, O, S, P or other heteroatoms together with from 1 to 10 carbon atoms or may contain from 1-3 ring-forming heteroatoms alone.

Ring-forming heteroatoms may in some cases bear oxygen atoms, as in aromatic and aliphatic N-oxides and ring systems containing the sulfinyl, sulfonyl, selenoxide and phosphine oxide groups. Selected carbon atoms contained in  $A_2$  and  $A_3$  may bear carbonyl, thiocarbonyl, substituted or unsubstituted imino groups or substituted or unsubstituted methyldene groups.

Bicyclic ring systems encompassed by  $R_2$  in formula 1 may include any bicyclic ring system of  $R_1$  and  $R_3$  having at least one nitrogen atom.

In regard to structures encompassed within formulae 3 and 4, it is noted as follows:

- (a) When  $B_2$  and  $B_3$  are both nitrogen, the groups  $A_2$  and  $A_3$  should each contain no fewer than three ring atoms;
- (b) When  $B_2$  but not  $B_3$  is nitrogen, either of  $A_2$  or  $A_3$  should contain at least three ring atoms and the other at least two ring atoms;
- (c) When either of groups  $A_2$  or  $A_3$  contains fewer than three ring atoms, the other should contain at least three ring atoms and the bridgehead atoms should be saturated;

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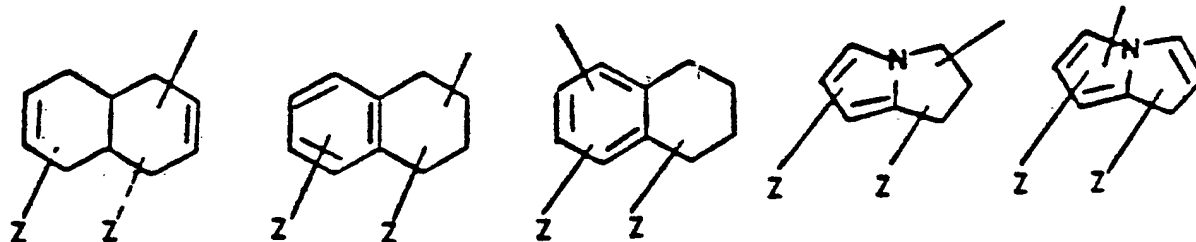
(d) When the group  $A_2$  or  $A_3$  contains a carbon atom bearing a carbonyl, thiocarbonyl, imino or methyldene group, it should together with  $B_2$  and  $B_3$  form a cycle having at least four members;

(e) When an annular double bond is exocyclic to either of the two rings represented in structures 3 and 4, it should be contained in a ring containing at least five members and be exocyclic to a ring containing at least five members; and

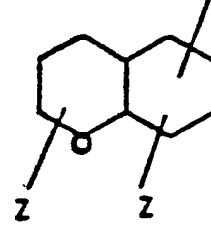
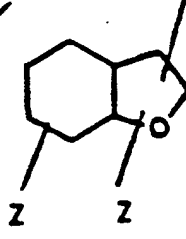
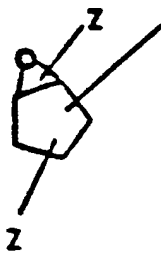
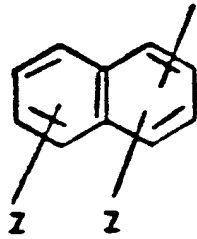
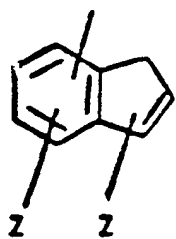
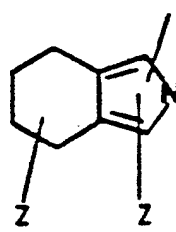
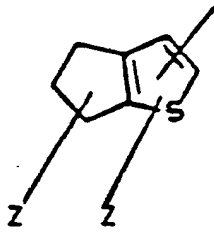
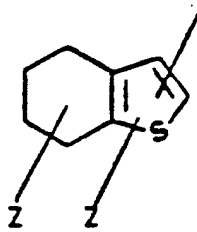
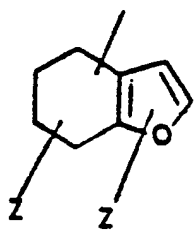
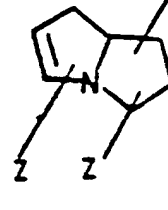
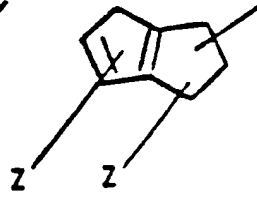
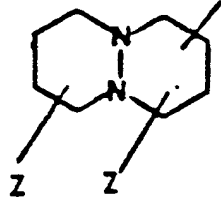
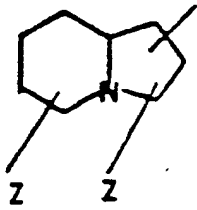
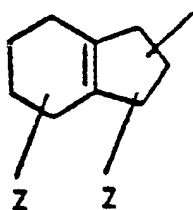
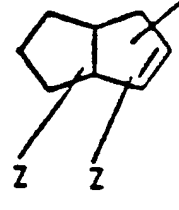
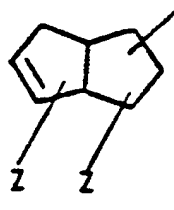
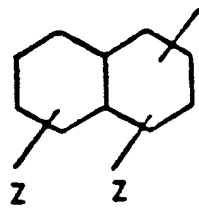
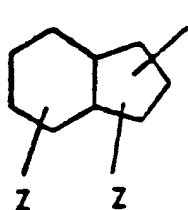
(f) When a group  $A_2$  or  $A_3$  is joined to the bridgehead atoms  $B_2$  and  $B_3$  by 2 double bonds, the group  $A_2$  or  $A_3$  is understood to contain one double bond and the bridgehead atoms are considered to be unsaturated.

It is recognized that bicyclic ring systems defined for  $R_1$  and  $R_3$  may be spirocyclic ring systems and are not limited to the fused bicyclic structures of formulae 3 and 4. Spirocyclic ring systems may be saturated or unsaturated carbocyclic or heterocyclic and may be independently substituted by one or more substituents Z as defined herein.

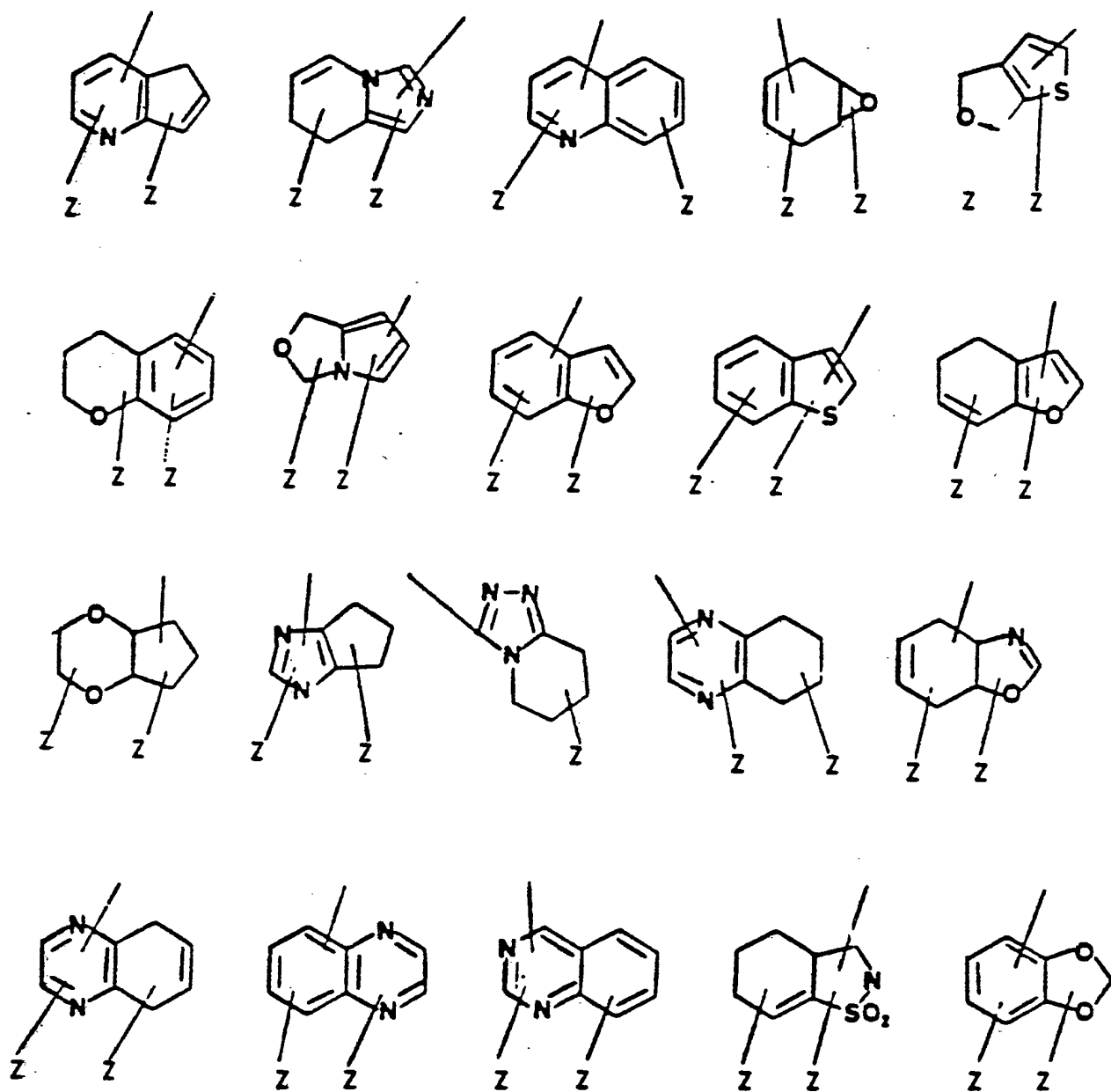
Illustrative bicyclic ring structures which are encompassed by  $R_1$  and  $R_3$  in formula 1 included the following:



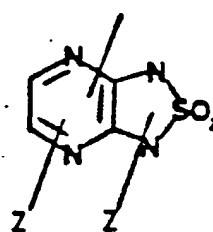
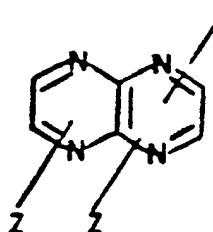
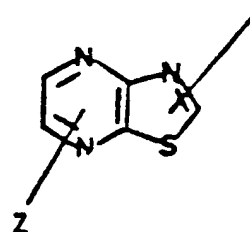
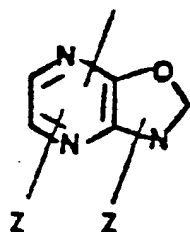
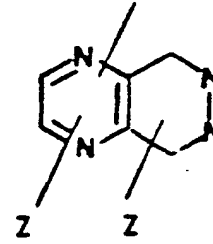
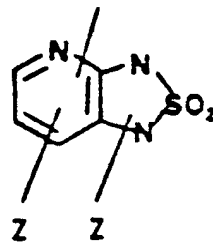
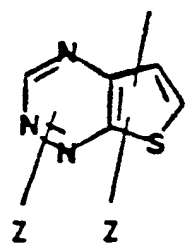
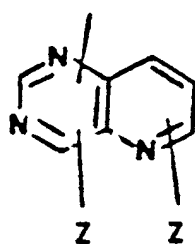
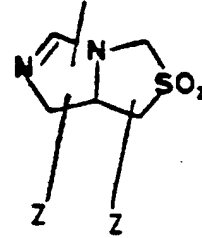
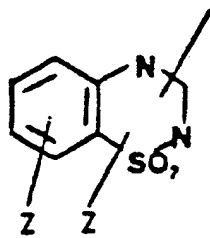
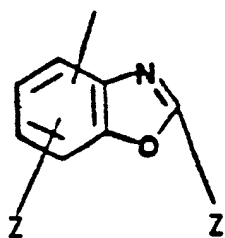
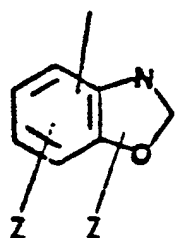
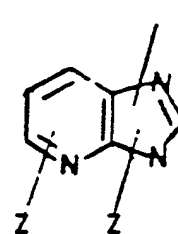
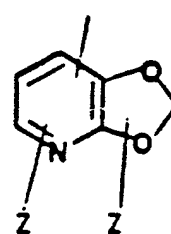
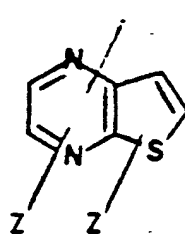
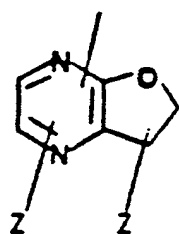
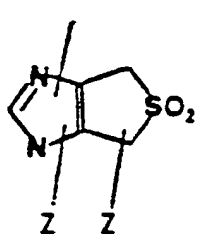
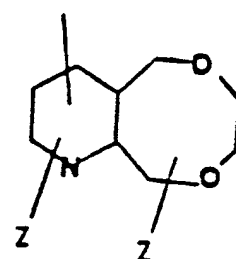
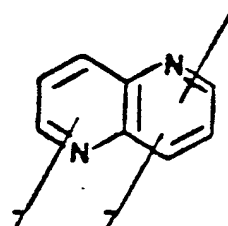
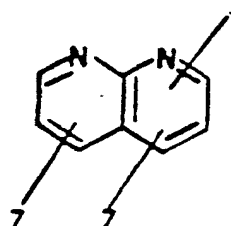
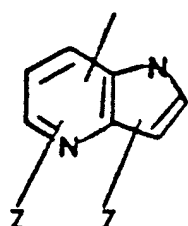
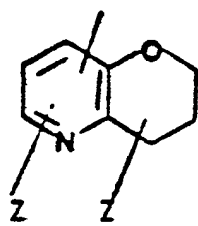
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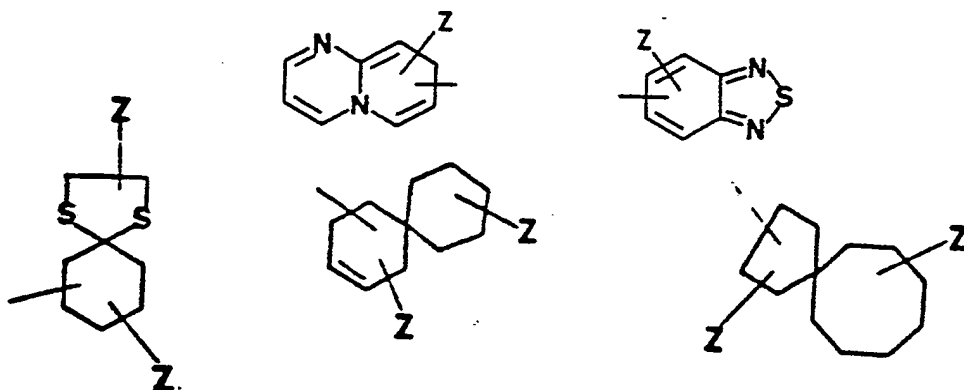
- 30 -



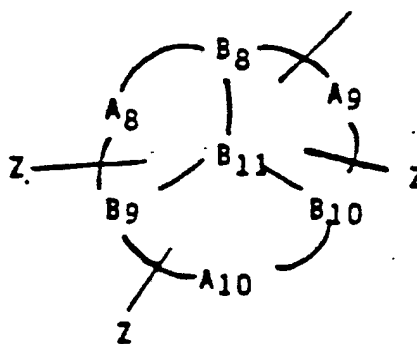
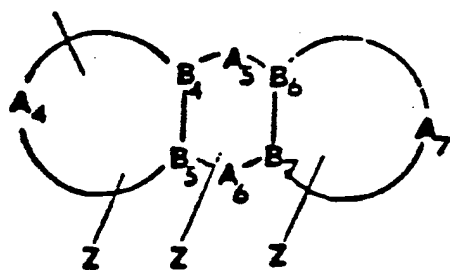
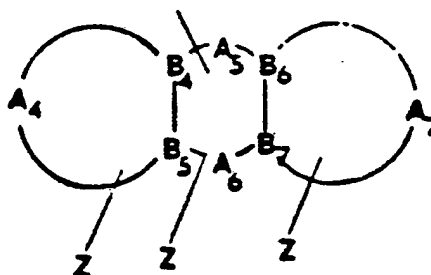
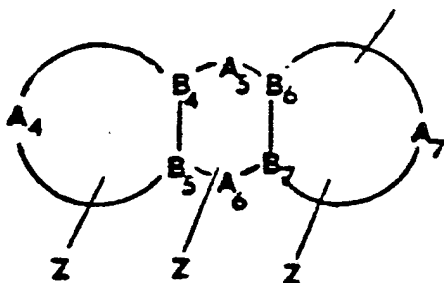
- 31 -



- 32 -



Polycyclic ring systems, i.e., greater than 2 rings, encompassed by  $R_1$  and  $R_3$  in formula 1 may be represented by generalized formulae 5, 6, 7 and 8 as follows:



- 33 -

wherein  $B_4$ ,  $B_5$ ,  $B_6$  and  $B_7$  may be independently a saturated or unsaturated carbon atom or a saturated nitrogen atom, and  $A_4$ ,  $A_5$ ,  $A_6$  and  $A_7$  independently represent ring forming chains of atoms which may contain together with one or the other (but not both) of their two associated bridgehead atoms, from 0-2 double bonds. The groups  $Z$  represent one or more substituents selected independently from among the group of substituents defined for  $Z$  herein.

The ring-forming elements of  $A_4$ ,  $A_5$ ,  $A_6$  and  $A_7$  independent of  $B_4$ ,  $B_5$ ,  $B_6$  and  $B_7$  may contain from 1-11 carbon atoms, may contain a combination of from 1-10 carbon atoms and from 1-3 heteroatoms which may be selected independently from among N, O, S, P or other heteroatoms, or may contain from 1-3 heteroatoms alone. Ring-forming heteroatoms may in some cases bear oxygen atoms as in aromatic N-oxides and ring systems containing the sulfinyl, sulfonyl, selenoxide and phosphine oxide groups. The group  $A_6$  may at times be defined as a bond. Selected carbon atoms contained in  $A_4$ ,  $A_5$ ,  $A_6$  and  $A_7$  may bear one or more carbonyl, thiocarbonyl or substituted or unsubstituted imino groups.

On structure 8 the groups  $B_8$ ,  $B_9$  and  $B_{10}$  represent independently a saturated or unsaturated carbon atom or a saturated nitrogen atom. The group  $B_{11}$  may represent a saturated or unsaturated carbon atom or a nitrogen or phosphorous atom. The groups  $A_8$ ,  $A_9$  and  $A_{10}$  represent ring-forming chains of atoms which may contain

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together with 1 of the groups  $B_8$ ,  $B_9$ ,  $B_{10}$  and  $B_{11}$  from 0-2 double bonds.

The ring-forming elements of groups  $A_8$ ,  $A_9$  and  $A_{10}$  independent of groups  $B_8$ ,  $B_9$ ,  $B_{10}$  and  $B_{11}$  may contain from 2-10 carbon atoms, may contain from 1-10 carbon atoms in combination with 1-3 heteroatoms which may be selected independently from among N, O, S, P or other heteroatoms, or may contain from 2-3 heteroatoms alone. Ring-forming heteroatoms may in some cases bear oxygen atoms as in aromatic N-oxides and in ring systems containing the sulfinyl, sulfonyl, selenoxide and phosphine oxide groups. Selected carbon atoms contained in groups  $A_8$ ,  $A_9$  and  $A_{10}$  may bear one or more carbonyl, thiocarbonyl or substituted or unsubstituted imino groups.

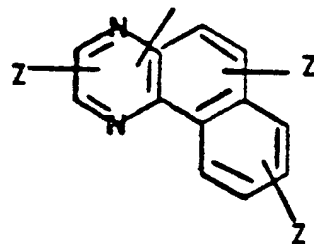
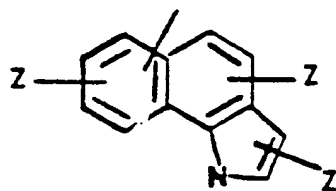
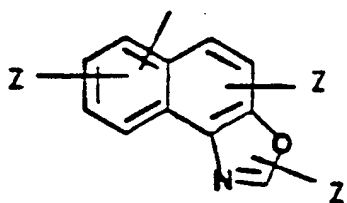
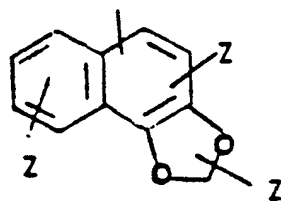
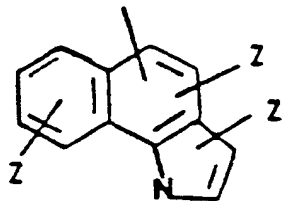
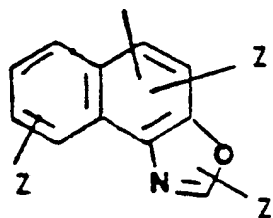
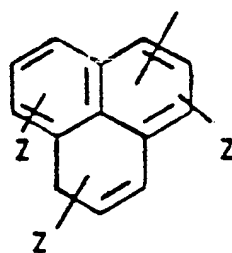
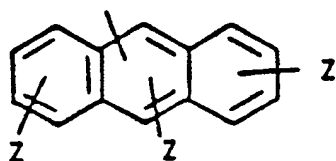
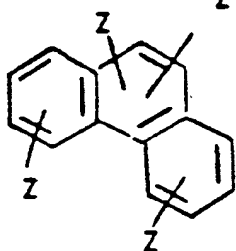
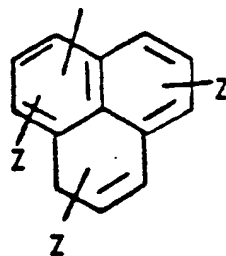
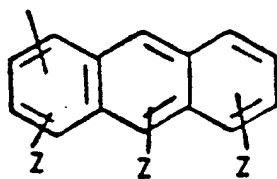
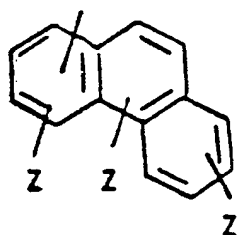
It is recognized that polycyclic ring systems defined for  $R_1$  and  $R_3$  may be spirocyclic ring systems and are not limited to the fused polycyclic structures of formulae 5, 6, 7 and 8. Spirocyclic ring systems may be saturated or unsaturated, carbocyclic or heterocyclic and may be independently substituted by one or more substituents Z as defined herein.

Polycyclic ring systems encompassed by  $R_2$  of formula 1 may include any polycyclic ring system or  $R_1$  and  $R_3$  having at least one nitrogen atom.

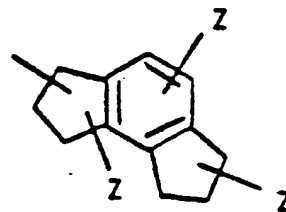
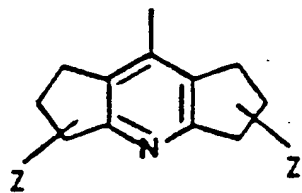
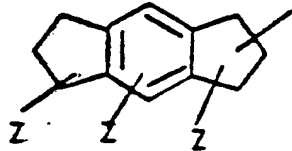
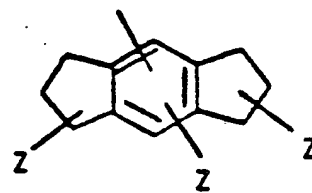
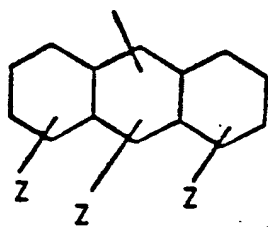
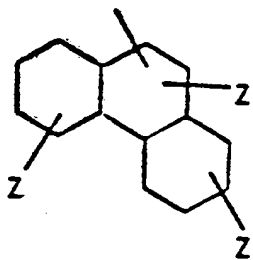
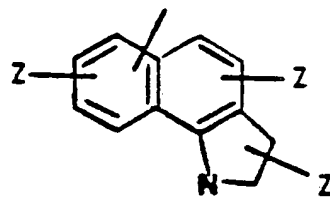
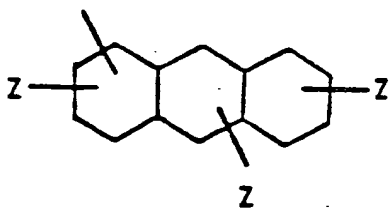
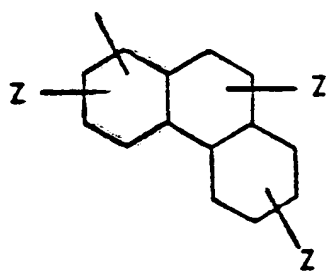
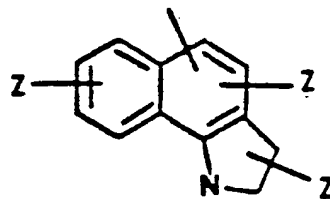
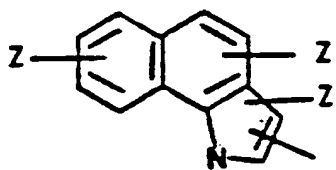
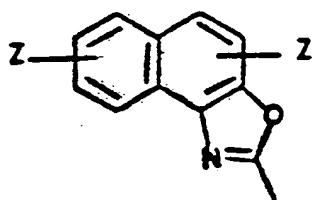
Illustrative polycyclic ring structures which are encompassed by  $R_1$  and  $R_3$  in formula 1 include the following:



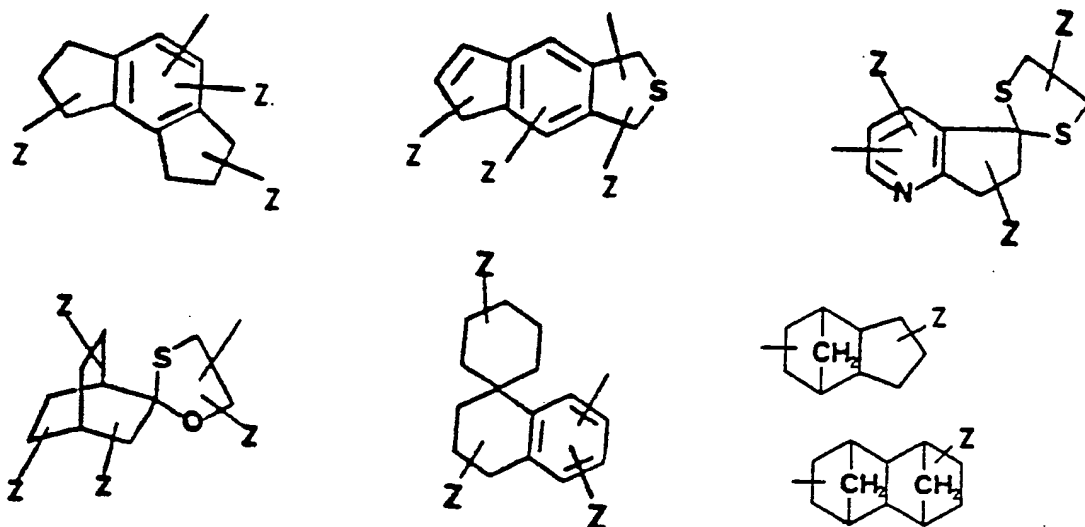
- 35 -



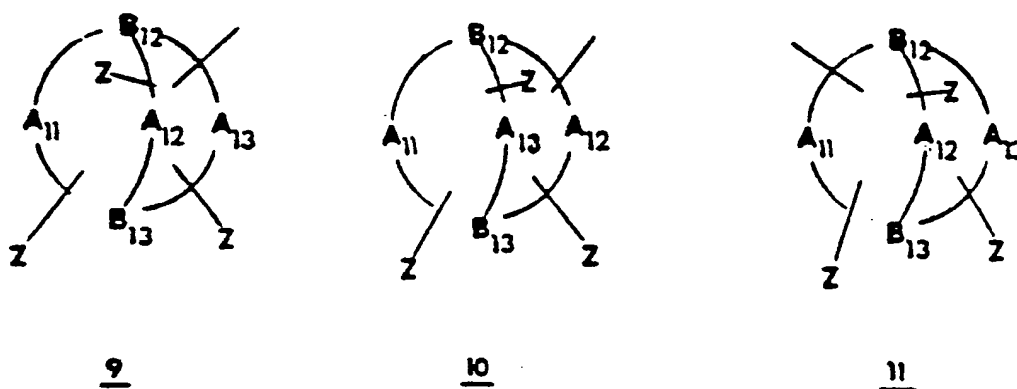
- 36 -



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Bridged bicyclic structures encompassed by  $R_1$  and  $R_3$  in formula 1 may be represented by generalized formulae 9, 10, and 11 as follows:



wherein  $B_{12}$  and  $B_{13}$  may be independently a saturated carbon atom optionally substituted by Z or a nitrogen atom, and the groups  $A_{11}$ ,  $A_{12}$  and  $A_{13}$  independently represent ring-forming chains of atoms which may contain, independently of  $B_{12}$  and  $B_{13}$ , from 0-2 double bonds. The groups Z represent one or more substituents selected independently from among the groups of substituents defined for Z herein.

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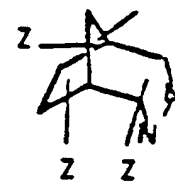
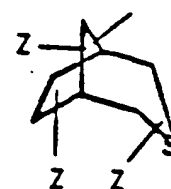
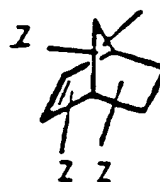
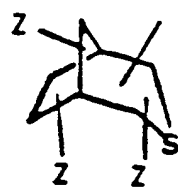
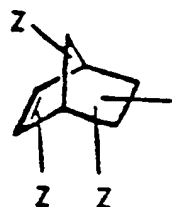
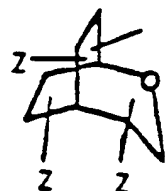
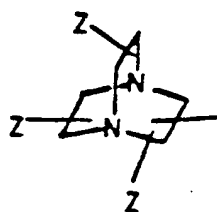
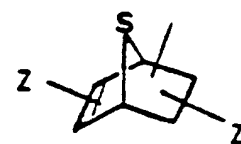
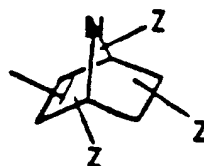
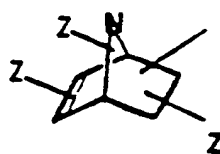
The ring-forming elements of  $A_{11}$ ,  $A_{12}$  and  $A_{13}$ , independent of  $B_{12}$  and  $B_{13}$ , may contain entirely from 1-11 carbon atoms, may contain a combination of from 1-10 carbon atoms and from 1-3 heteroatoms which may be selected independently from among N, O, S, P or other heteroatoms, or may contain from 1-3 heteroatoms alone with the proviso that when one of the groups  $A_{11}$ ,  $A_{12}$  and  $A_{13}$  is a single heteroatom, the other two groups should contain two or more ring-forming atoms. A second proviso is that when one or both of the groups  $B_{12}$  and  $B_{13}$  is nitrogen, the groups  $A_{11}$ ,  $A_{12}$  and  $A_{13}$  should contain at least two saturated ring-forming atoms.

Ring-forming heteroatoms may in some cases bear oxygen atoms as in the sulfinyl, sulfonyl, selenoxide and phosphine oxide moieties. Selected carbon atoms contained in  $A_{11}$ ,  $A_{12}$  and  $A_{13}$  may bear one or more carbonyl, thiocarbonyl or substituted or unsubstituted imino groups.

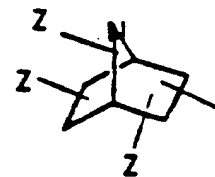
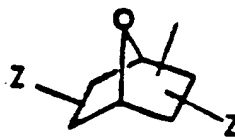
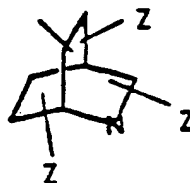
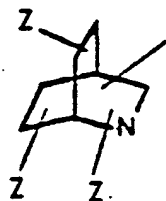
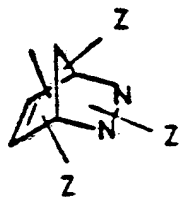
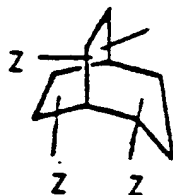
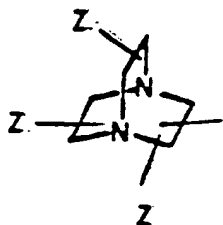
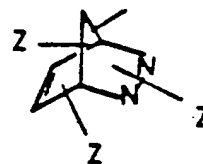
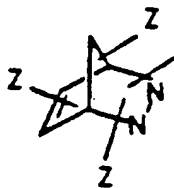
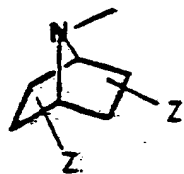
Bridged bicyclic structures encompassed by  $R_2$  of formula 1 may include any bicyclic bridged system of  $R_1$  and  $R_3$  having at least one nitrogen atom.

Illustrative bridged bicyclic structures which are encompassed by  $R_1$  and  $R_3$  in formula 1 include the following:

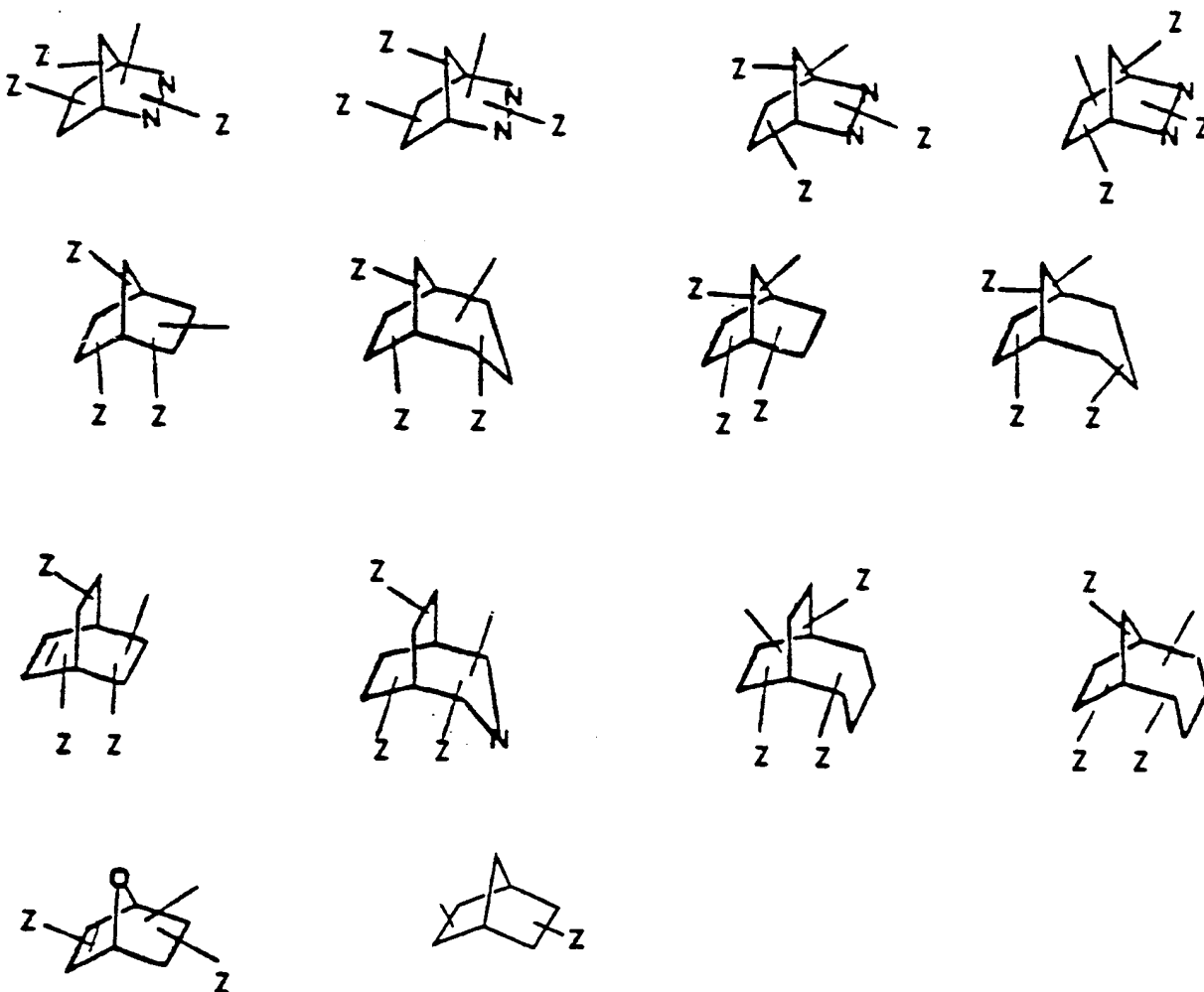
- 39 -



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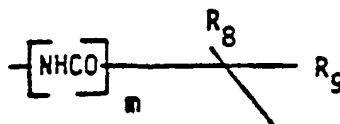
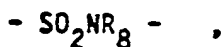
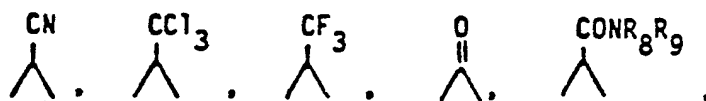
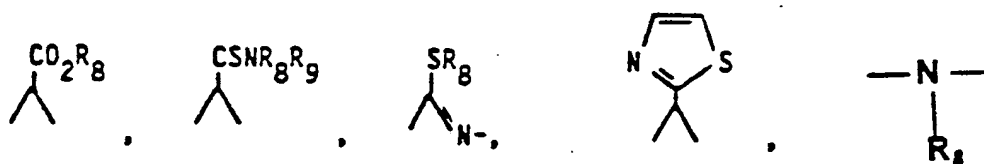


The substituent X may be an unsubstituted heteroatom such as an oxygen or sulfur, as in carbonyl and thiocarbonyl systems, or may be a substituted heteroatom or carbon atom. X may also be a covalent single or double bond. X may further be a saturated or unsaturated, branched or straight chain of carbon atoms; a branched or straight, saturated or unsaturated chain of atoms consisting

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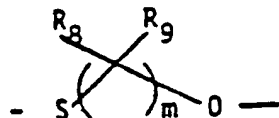
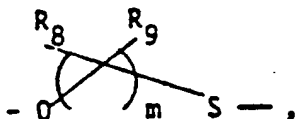
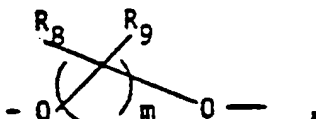
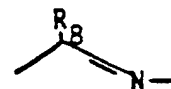
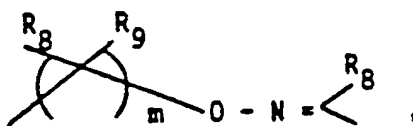
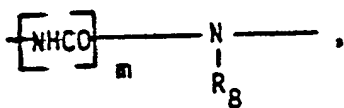
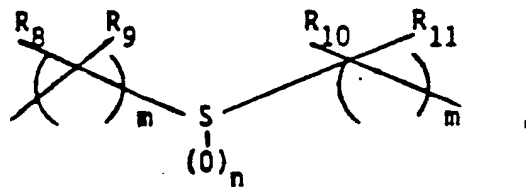
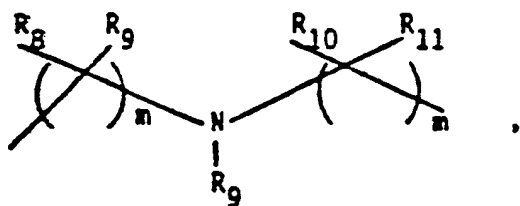
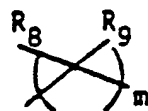
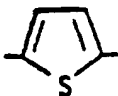
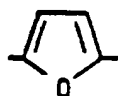
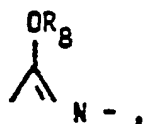
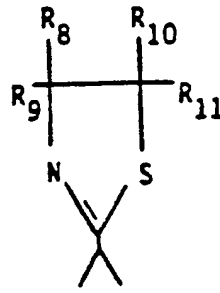
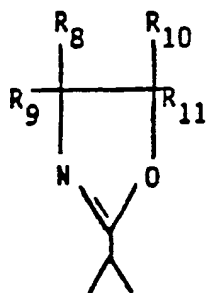
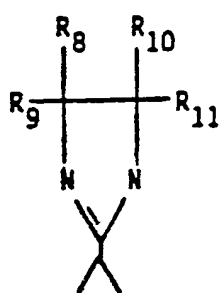
of both carbon atoms and heteroatoms; or may be a branched or straight, saturated or unsaturated chain consisting entirely of heteroatoms. Selected heteroatomic components of X may bear oxygen atoms as in the case of groups containing the sulfonyl, sulfinyl, N-oxide and phosphine oxide moieties. Selected heteroatomic components of X may bear one or more substituents Z as defined herein. Selected carbon atoms participating in X may bear carbonyl, thiocarbonyl, substituted or unsubstituted imino, substituted or unsubstituted alkylidene or one or more substituents Z as defined herein.

Illustrative structures which are encompassed by substituent X include the following:

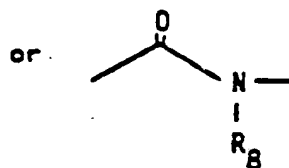
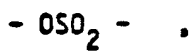
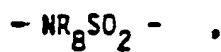
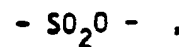
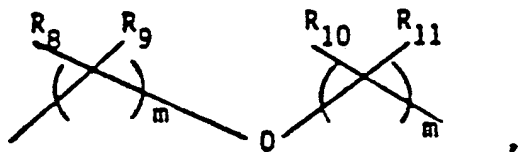
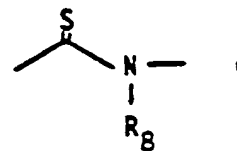
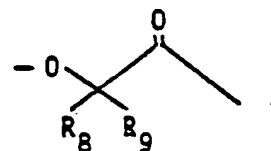
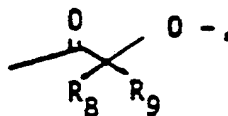
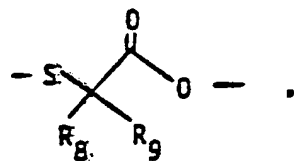
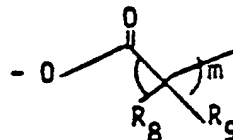
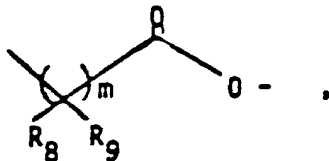
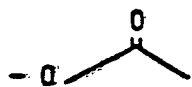
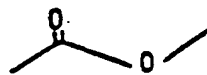
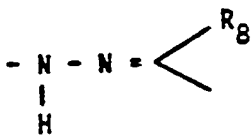
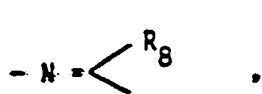




- 43 -



- 44 -



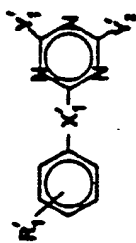
- 45 -

wherein m is a value of from 0 to 8, n is a value of from 0 to 2, and  $R_8$ ,  $R_9$ ,  $R_{10}$  and  $R_{11}$  are independently hydrogen or substituted or unsubstituted alkyl, polyhaloalkyl, phenyl or benzyl in which the permissible substituents are as defined for Z herein.

It is readily apparent that formula 1 encompasses a wide variety of heterocyclic nitrogen-containing compounds. Illustrative heterocyclic nitrogen-containing compounds within the scope of formula 1 which may be used for reducing transpirational moisture loss from plants and increasing crop yield are included in Tables 1 through 43 below.

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TABLE 1  
Representative Heterocyclic Nitrogen - Containing Compounds

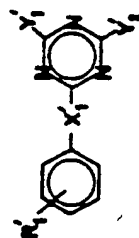


R <sub>1</sub>	X <sub>1</sub>	Y <sub>1</sub>	Y <sub>2</sub>
H	0	Cl	Cl
4-Cl	0	Cl	Cl
4-F	0	Cl	Cl
2,4-Cl <sub>2</sub>	0	Cl	Cl
4-CH <sub>3</sub>	0	Cl	Cl
4-CH <sub>3</sub> O	0	Cl	Cl
3,4-Cl <sub>2</sub>	0	Cl	Cl
2,3-Cl <sub>2</sub>	0	Cl	Cl
2,5-Cl <sub>2</sub>	0	Cl	Cl
3-Cl	0	Cl	Cl
2-Cl	0	Cl	Cl
3,5-Cl <sub>2</sub>	0	Cl	Cl
4-CF <sub>3</sub>	0	Cl	Cl
4-C <sub>6</sub> H <sub>5</sub> O-	0	Cl	Cl
2-NO <sub>2</sub>	0	Cl	Cl
3-NO <sub>2</sub>	0	Cl	Cl
4-NO <sub>2</sub>	0	Cl	Cl
2,4-Cl <sub>2</sub>	0	Cl	OCH <sub>3</sub>

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TABLE I (Cont.)

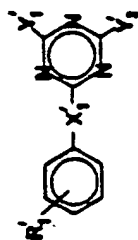
Representative Heterocyclic Nitrogen - Containing Compounds



R <sub>1</sub>	X <sub>1</sub>	Y <sub>1</sub>	Y <sub>2</sub>
3-CN	O	Cl	Cl
4-Cl	O	F	F
4-CN	O	Cl	Cl
2,6-Cl <sub>2</sub>	O	Cl	Cl
4-CO <sub>2</sub> CH <sub>3</sub>	O	Cl	Cl
4-CH <sub>2</sub> CO <sub>2</sub> CH <sub>3</sub>	O	Cl	Cl
4-C <sub>6</sub> H <sub>5</sub> CO-	O	Cl	Cl
4-CH <sub>3</sub> CO-	O	Cl	Cl
2,3,4,5-Cl <sub>4</sub>	O	Cl	Cl
2,3,4,5,6-Cl <sub>5</sub>	O	Cl	Cl
4-(CH <sub>3</sub> ) <sub>3</sub> C-	O	Cl	Cl
4-CH <sub>3</sub> S-	O	Cl	Cl
4-(C <sub>6</sub> H <sub>5</sub> ) <sub>3</sub> C-	O	Cl	Cl
3,4-CH <sub>2</sub> O-	O	Cl	Cl
3-CH <sub>3</sub> CONH-	O	Cl	Cl
3-CH <sub>3</sub> O-	O	Cl	Cl
4-C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> O-	O	Cl	Cl

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TABLE I (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds




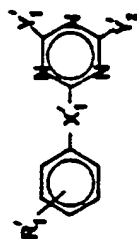
R <sub>1</sub>	X <sub>1</sub>	V <sub>1</sub>	V <sub>2</sub>
4-(  )	O	Cl	Cl
4-[(C <sub>2</sub> H <sub>5</sub> CH(CH <sub>3</sub> )O)-]	O	Cl	Cl
3,4,5-(CH <sub>3</sub> ) <sub>3</sub>	O	Cl	Cl
3,5-(CH <sub>3</sub> ) <sub>2</sub> -4-Br	O	Cl	Cl
2-Br-4-Cl	O	Cl	Cl
4-O-CH-	O	Cl	Cl
4-n-C <sub>4</sub> H <sub>9</sub> O-	O	Cl	Cl
4-n-C <sub>7</sub> H <sub>15</sub> O-	O	Cl	Cl
4-Cl-5,6-(CH <sub>2</sub> ) <sub>4</sub> -	O	Cl	Cl
3-(CH <sub>3</sub> ) <sub>2</sub> N-	O	Cl	Cl
4-(C <sub>6</sub> H <sub>5</sub> -N=N-)	O	Cl	Cl
2,4-Cl <sub>2</sub> -6-COOH	O	Cl	Cl
4-C <sub>6</sub> H <sub>5</sub>	O	Cl	Cl
3-F	O	Cl	Cl
2,4-Cl <sub>2</sub>	O	Br	Br

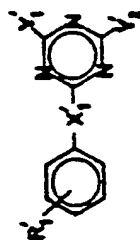
TABLE 1 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



R'1	X'1	Y'1	Y'2
2,4-Cl2	0	Cl	I
4-(4-C2H5O-C6H4N=N)- 2,3-(CH=CH-CH=CH)-	0	Cl	Cl
2-CH3O-4-allyl	0	Cl	Cl
2,4-Cl2	0	Cl	CH3
2,4-Cl2	0	Br	CH3
3,4-(CH=CH-CH=CH)-	0	Cl	Cl
2,3-(CH2)4-	0	Cl	Cl
2,3-(CH2)4-4-Cl	0	Cl	Cl
2,3-(CH=CH-CH=CH)-	0	Cl	Cl
2,3-(CH=CH-CH=CH)-4-Cl-	0	Cl	Cl
2,3-(CH=CH-CH=CH)-4-CH3O	0	Cl	Cl
4-Cl	S	Cl	Cl
3-Cl	S	Cl	Cl
2,6-Cl2	S	Cl	Cl
4-CH3	S	Cl	Cl
2,4-Cl2	S	Cl	Cl

TABLE 1 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

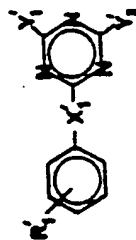


R <sup>1</sup>	X <sup>1</sup>	Y <sup>1</sup>	Y <sup>2</sup>
4-CH <sub>3</sub> O	S	Cl	Cl
4-F	S	Cl	Cl
4-Cl-2-CH(CH <sub>3</sub> )C <sub>6</sub> H <sub>5</sub>	O	Cl	Cl
2-Cl	NH	Cl	Cl
4-Cl	NH	Cl	Cl
4-Cl	NH	F	F
4-(4-Cl-2-BrC <sub>6</sub> H <sub>4</sub> O)-2-CH <sub>3</sub>	NH	Cl	Cl
2-CH <sub>3</sub> -4-(4-Cl-2-BrC <sub>6</sub> H <sub>4</sub> O)-5-Cl	NH	Cl	Cl
4-Cl	NH	Br	Br
4-NO <sub>2</sub>	NH	Cl	Cl
4-NO <sub>2</sub>	NH	Br	Br
4-(C <sub>6</sub> H <sub>5</sub> -CH <sub>2</sub> )-	O	Cl	Cl



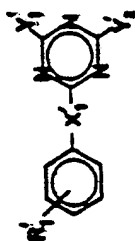


TABLE 1 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R <sub>1</sub>	X <sub>1</sub>	Y <sub>1</sub>	Y <sub>2</sub>
3-n-C <sub>4</sub> H <sub>9</sub> O	O	Cl	Cl
3-	O	Cl	Cl
3-C <sub>6</sub> H <sub>5</sub> -CH <sub>2</sub> O-	O	Cl	Cl
4-[4-(C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> O)-C <sub>6</sub> H <sub>4</sub> CH <sub>2</sub> O]-	O	Cl	Cl
2-Br	O	Cl	Cl
2-CH <sub>3</sub> O-4-CHO	O	Cl	Cl
2,3-(CH <sub>2</sub> ) <sub>4</sub> -	NH	Cl	Cl
2,3-O-C(CH <sub>3</sub> ) <sub>2</sub> O-	O	Cl	Cl
3-CH <sub>2</sub> =CHCH <sub>2</sub> O-	O	Cl	Cl
3-ClCH <sub>2</sub> CH <sub>2</sub> O-	O	Cl	Cl
3-CH <sub>3</sub> SO <sub>2</sub> -O-	O	Cl	Cl
2-CH <sub>3</sub> O-	O	Cl	Cl
2-n-C <sub>7</sub> H <sub>15</sub> O-	O	Cl	Cl

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Representative Heterocyclic Nitrogen - Containing Compounds



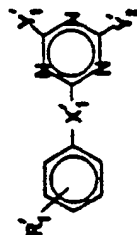
<u>R<sub>1</sub></u>	<u>X<sub>1</sub></u>	<u>Y<sub>1</sub></u>	<u>Y<sub>2</sub></u>
2-(  )-	O	Cl	Cl
2-C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> O-	O	Cl	Cl
2-(  )-	O	Cl	Cl
2-n-C <sub>4</sub> H <sub>9</sub> O-4-Br	O	Cl	Cl
2-1-C <sub>3</sub> H <sub>7</sub> O-3-Cl	O	Cl	Cl
2-C <sub>6</sub> H <sub>5</sub> SO <sub>2</sub> -O-	O	Cl	Cl
2-CF <sub>3</sub> CO <sub>2</sub> -	O	Cl	Cl
2-n-C <sub>4</sub> H <sub>9</sub> CO-	O	Cl	Cl
2-C <sub>2</sub> H <sub>5</sub> O-C-O-	O	Cl	Cl
0			
2-BrCH <sub>2</sub> CH <sub>2</sub> -	O	Cl	Cl
2-CH <sub>2</sub> -C(CH <sub>3</sub> )CH <sub>2</sub> -	O	Cl	Cl

TABLE I (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



$R_1$	$X_1$	$Y_1$	$Y_2$
4-HO	0	Cl	Cl
3-HO	0	Cl	Cl
2-HO	0	Cl	Cl
4-(1-C <sub>3</sub> H <sub>7</sub> )-	0	Cl	Cl
3-C <sub>2</sub> H <sub>5</sub> -	0	Cl	Cl
3-(CH <sub>3</sub> ) <sub>3</sub> C-	0	Cl	Cl
2-n-C <sub>4</sub> H <sub>9</sub> -	0	Cl	Cl
2-sec-C <sub>4</sub> H <sub>9</sub> -	0	Cl	Cl
2-Cl-4-n-C <sub>3</sub> H <sub>7</sub>	0	Cl	Cl
2-C <sub>2</sub> H <sub>5</sub> -4-Br	0	Cl	Cl

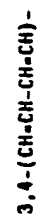
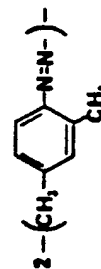


TABLE 1 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

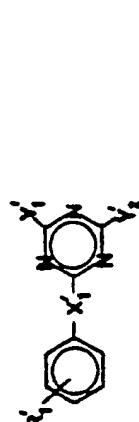
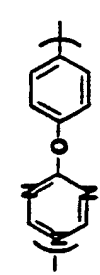
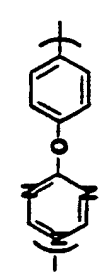
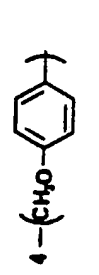
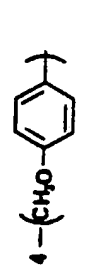
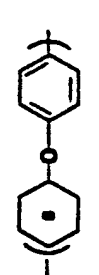
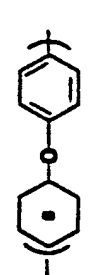


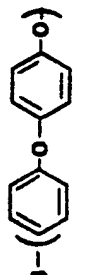
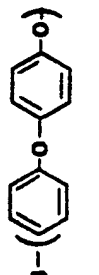
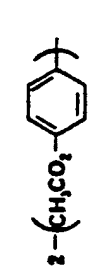
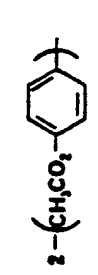
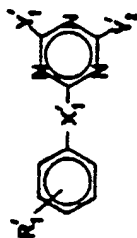
	R'1	X'1	Y'1	Y'2
4-(  )		0	Cl	Cl
4-(  )		0	Cl	Cl
4-(  )		0	Cl	Cl
2-n-PrO- 		0	Cl	Cl
3-(  )		0	Cl	Cl
2-(  )		0	Cl	Cl

TABLE I (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



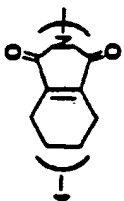
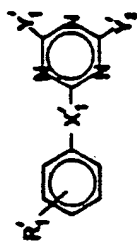
R <sub>1</sub>	X <sub>1</sub>	Y <sub>1</sub>	Y <sub>2</sub>
4-((  )	O	Cl	Cl
4-n-C <sub>4</sub> H <sub>9</sub> S-	O	Cl	Cl
2-1-C <sub>3</sub> H <sub>7</sub> S-	O	Cl	Cl
3-n-C <sub>7</sub> H <sub>15</sub> S-	O	Cl	Cl
4-HC≡CCH <sub>2</sub> O-	O	Cl	Cl
3-HC≡CCH <sub>2</sub> O-	O	Cl	Cl
2-HC≡CCH <sub>2</sub> O-	O	Cl	Cl
4-(C <sub>2</sub> H <sub>5</sub> SCH <sub>2</sub> O)-	O	Cl	Cl
3-(C <sub>2</sub> H <sub>5</sub> SCH <sub>2</sub> O)-	O	Cl	Cl
2-(C <sub>2</sub> H <sub>5</sub> SCH <sub>2</sub> O)-	O	Cl	Cl
4-(C <sub>2</sub> H <sub>5</sub> O-C-CH <sub>2</sub> O) O	O	Cl	Cl

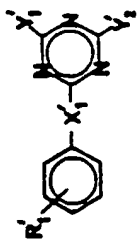
TABLE 1 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R'1	X'1	Y'1	Y'2
3-(())	O	Cl	Cl
2-[(CH3)3C-O-C(=O)-CH2O-]	O	Cl	Cl
3,5-(CH3O)2	O	Cl	Cl
3,5-(C6H5CH2O)2	O	Cl	Cl
3,5-(CH3CO2)2	O	Cl	Cl
2,6-(C2H5O)2	O	Cl	Cl
2-C6H5-	O	Cl	Cl
3-C6H5-	O	Cl	Cl
3-C6H5-O	O	Cl	Cl
2-Cl-4-Br	O	Cl	Cl
2-Cl-4-F	O	Cl	Cl
2,4-F2	O	Cl	Cl

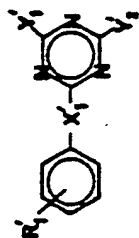
TABLE 1 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



R'1	X'1	Y'1	Y'2
2-F-4-Cl-	O	Cl	Cl
2-NO <sub>2</sub> -3-C <sub>2</sub> H <sub>5</sub>	NH	Cl	Cl
2,4-(NO <sub>2</sub> ) <sub>2</sub>	NH	Cl	Cl
2,5-(CH <sub>3</sub> C) <sub>2</sub>	NH	Cl	Cl
O			
2,3,4-Cl <sub>3</sub>	NH	Cl	F
2-CH <sub>3</sub> O-CH <sub>2</sub> -	NH	F	F
2,4-(C <sub>2</sub> H <sub>5</sub> C) <sub>2</sub>	NH	Cl	Cl
O			
4-C <sub>6</sub> H <sub>5</sub> SO <sub>2</sub> -2,3-(CH <sub>3</sub> ) <sub>2</sub>	NH	Cl	Cl
3-(4-Cl-C <sub>6</sub> H <sub>4</sub> O)	NH	F	F
2,3-(CH <sub>3</sub> SO <sub>2</sub> ) <sub>2</sub>	NH	Cl	Cl
4-(2-Cl-4-BrC <sub>6</sub> H <sub>4</sub> )	NH	Cl	Cl
2-Cl-4-n-C <sub>4</sub> H <sub>9</sub> O-	O	Cl	Cl

TABLE 1 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



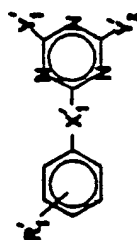
$R'1$	$X'1$	$Y'1$	$Y'2$
2-F-4-((cyclohexyl)-O)-	O	Cl	Cl
3-Cl-4-CH <sub>3</sub> O-	O	Cl	Cl
4-(Cl-C <sub>6</sub> H <sub>4</sub> -SO <sub>2</sub> -O-)	O	Cl	Cl
4-(Cl-C <sub>6</sub> H <sub>4</sub> -SO <sub>2</sub> -O-)	O	Cl	Cl
4-(n-C <sub>4</sub> H <sub>9</sub> O-C-O-)	O	Cl	Cl
4-(CF <sub>3</sub> -CO-)	O	Cl	Cl
4-((CH <sub>3</sub> ) <sub>3</sub> C-C-)	O	Cl	Cl

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TABLE 1 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds




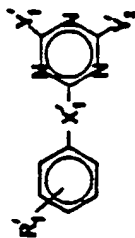
R <sub>1</sub>	X <sub>1</sub>	Y <sub>1</sub>	Y <sub>2</sub>
3-CH <sub>3</sub> CO-	O	Cl	Cl
4-Cl-3-(  )	O	Cl	Cl
2-Br-3-n-C <sub>4</sub> H <sub>9</sub> O-	O	Cl	Cl
3-n-C <sub>3</sub> H <sub>7</sub> C-O-	O	Cl	Cl
3-(CH <sub>3</sub> O-C-O-)	O	Cl	Cl
2-CH <sub>3</sub> O-4-(CH <sub>3</sub> ) <sub>3</sub> C-	O	Cl	Cl
4-C <sub>6</sub> H <sub>5</sub> CH-CHCO-	O	Cl	Cl
2,6-Cl <sub>2</sub> -4-NO <sub>2</sub>	O	Cl	Cl
4-CONH <sub>2</sub>	O	Cl	Cl
3-C <sub>6</sub> H <sub>5</sub> NHCO-	O	F	F
4-CONHNH <sub>2</sub>	O	Cl	Cl
4-CH-C(CH <sub>3</sub> ) <sub>2</sub>	O	Cl	Cl

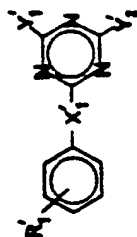
TABLE 1 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds





$R'1$	$X'1$	$Y'1$	$Y'2$
2-CH <sub>3</sub> O-4-CH <sub>3</sub> C(NO <sub>2</sub> )-CH-	O	Cl	Cl
4-CH <sub>3</sub> SO <sub>2</sub>	O	Cl	Cl
2-CH <sub>3</sub> -4-Cl-	O	Cl	Cl
2-CH <sub>2</sub> Cl-4-NO <sub>2</sub>	O	Cl	Cl
2,4-Cl <sub>2</sub> -3,5-(CH <sub>3</sub> ) <sub>2</sub> -	O	Cl	Cl
2-ClHg-4-NO <sub>2</sub>	O	Cl	Cl
4-NO <sub>2</sub>	S	Cl	Cl
4-(CH <sub>3</sub> ) <sub>3</sub> C-	S	Cl	Cl
2,4-Cl <sub>2</sub> -5-CH <sub>3</sub>	S	Cl	Cl
2,3-(CH=CH-CH=CH)-	S	Cl	Cl
4-C <sub>6</sub> H <sub>5</sub> O-	S	Cl	Cl
2,4-Cl <sub>2</sub>	S	F	F
2,4-Cl <sub>2</sub>	S	Br	Br
3,5-Cl <sub>2</sub>	S	Cl	Cl
3-C <sub>6</sub> H <sub>5</sub> O-	S	F	I
2,4-Cl <sub>2</sub>	O	F	F
2,4-Cl <sub>2</sub>	O	Br	Br

TABLE 1 (Cont.)

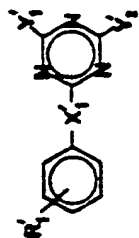
Representative Heterocyclic Nitrogen - Containing Compounds



R <sup>1</sup>	X <sup>1</sup>	Y <sup>1</sup>	Y <sup>2</sup>
3,5-Cl <sub>2</sub>	O	Cl	Cl
3-C <sub>6</sub> H <sub>5</sub> O-	O	F	I
3-(4-Cl-C <sub>6</sub> H <sub>4</sub> CO-)	S	Cl	Cl
2-NO <sub>2</sub>	S	Cl	Cl
3-(C <sub>6</sub> H <sub>5</sub> -O-  )	S	Cl	Cl
3-(4-Cl-C <sub>6</sub> H <sub>4</sub> CO-)	O	Cl	Cl
2-NO <sub>2</sub>	O	Cl	Cl
3-(C <sub>6</sub> H <sub>5</sub> -O-  )	O	Cl	Cl
3-C <sub>5</sub> H <sub>11</sub> O-	S	Cl	Cl
2,3,5-(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> -	S	Cl	Cl

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TABLE 1 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

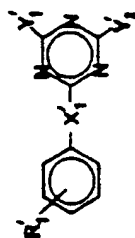


R'1	X'1	Y'1	Y'2
4-(H <sub>2</sub> N-COCH <sub>2</sub> -)	O	Cl	Cl
4-CO <sub>2</sub> (CH <sub>2</sub> ) <sub>11</sub> CH <sub>3</sub>	O	Cl	Cl
3-(  )	O	Cl	Cl
4-(H <sub>2</sub> NC-NH-) S	O	Cl	Cl
2,4-Cl <sub>2</sub> -5-CH <sub>3</sub>	O	Cl	Cl
2-Cl-4-NO <sub>2</sub>	O	Cl	Cl
2-CH <sub>2</sub> OH-4-Cl	NH	Cl	Cl
2-CH <sub>2</sub> OCH <sub>3</sub>	NH	Cl	Cl
2-CH <sub>3</sub> CO-4-Cl	NH	Cl	Cl
2-C <sub>6</sub> H <sub>5</sub>	O	Cl	Cl

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TABLE I (Cont.)

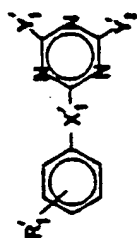
Representative Heterocyclic Nitrogen - Containing Compounds



$R'_1$	$X'_1$	$Y'_1$	$Y'_2$
$4-CH_2CO_2-C_6H_4-C(CH_3)_2$	O	Cl	Cl
$4-CH_2O-C_6H_4-C(CH_3)_2$	O	Cl	Cl
$4-CH_2O-C_6H_2(Cl)_2-C(CH_3)_2$ -2,6-Cl <sub>2</sub>	O	Cl	Cl
$4-C_6H_4O-C_6H_4-S$	O	Cl	Cl
$4-C_6H_4O-C_6H_4-S$	S	Cl	Cl

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TABLE I (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

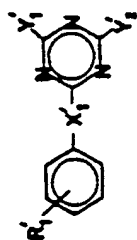


R'1	X'1	Y'1	Y'2
$\left[ \text{CH}_2\text{SO}_2\text{O}-\text{C}_6\text{H}_4-\text{S} \right]$	0	Cl	Cl
$\left[ \text{CH}_2\text{CO}_2-\text{C}_6\text{H}_4-\text{S} \right]$	0	Cl	Cl
$\left[ \text{Cl}-\text{C}_6\text{H}_4-\text{S} \right]$	0	Cl	Cl
$\left[ \text{HC}=\text{CCH}_2\text{O}-\text{C}_6\text{H}_4-\text{C}(\text{CH}_3)_2 \right]$	0	Cl	Cl
$\left[ \text{CH}_2\text{O}-\text{C}_6\text{H}_4-\text{S}(=\text{O})_2 \right]$	0	Cl	Cl

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TABLE I (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



R'1	X'1	Y'1	Y'2
	0	Cl	Cl
	0	Cl	Cl
	0	Cl	Cl
	NH	Cl	Cl
	0	Cl	Cl

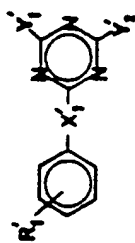
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TABLE 1 (Cont.)

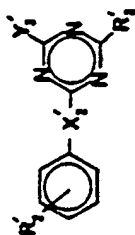
Representative Heterocyclic Nitrogen - Containing Compounds



$R'_1$	$X'_1$	$Y'_1$	$Y'_2$
2-CH <sub>3</sub> -O-4-CO <sub>2</sub> H	O	Cl	Cl
2,3,4,5,6-F <sub>5</sub>	O	Cl	Cl
3-CF <sub>3</sub>	O	Cl	Cl
2,4,5-Cl <sub>3</sub>	O	Cl	Cl
3-C <sub>6</sub> H <sub>5</sub>	O	Cl	Cl

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TABLE 2  
Representative Heterocyclic Nitrogen - Containing Compounds

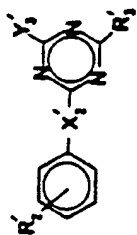


R'2	X'2	Y'3	R'3
2,4-Cl2	O	Cl	
4-Cl	O	F	
3-(CH3)2N-	O	Cl	
2,4-F2	O	Cl	
2,4-Cl2	O	Cl	CH3
2,4-Cl2	O	Br	CH3
2,3-(CH=CH-CH=CH)-	O	Cl	CH3
2,4-Cl2	O	Cl	CH3O

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TABLE 2 (Cont.)

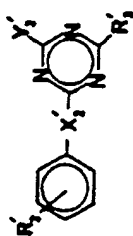
Representative Heterocyclic Nitrogen - Containing Compounds



R'2	X'2	Y'3	R'3
2,4-Cl2	O	Cl	P(-O)(OC2H5)2
H	O	Cl	
2,4-Cl2-6-CO2H	O	Cl	
2,4-Cl2	O	Cl	OCH2CF3
2,4-Cl2	O	Cl	CN
2,4-Cl2	O	Cl	SCH3
H	O	Cl	CCl3
2,4-Cl2	O	Cl	CH3CO-
2,4-Cl2	O	Cl	CH3COCH2-
2,4-Cl2	O	Cl	CF3
2,4-Cl2	O	Cl	CH3SO2
2,4-Cl2	O	Cl	-SC≡N
2,4-Cl2	O	Cl	H

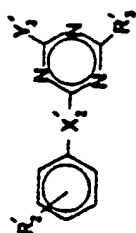
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TABLE 2 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



$R'_2$	$X'_2$	$Y'_3$	$R'_3$
3-NO <sub>2</sub>	O	Cl	H
2,4-Cl <sub>2</sub>	O	Cl	-C≡CH
2,4-Cl <sub>2</sub>	O	Cl	-CH=CH <sub>2</sub>
3-NO <sub>2</sub>	O	Cl	-C≡CH
2,4-Cl <sub>2</sub>	O	F	-C≡CH
2,4-Cl <sub>2</sub>	O	Cl	CHF <sub>2</sub>
2,4-Cl <sub>2</sub>	O	Cl	CONH <sub>2</sub>
2,4-Cl <sub>2</sub>	O	Cl	-C(CH <sub>2</sub> ) <sub>2</sub> Cl
			S
2,4-Cl <sub>2</sub>	O	Cl	CH <sub>2</sub> CO <sub>2</sub> C <sub>2</sub> H <sub>5</sub>
2,4-Cl <sub>2</sub>	O	F	-N(CH <sub>3</sub> ) <sub>2</sub>
2,4-Cl <sub>2</sub>	O	Cl	-P(-O)(OC <sub>6</sub> H <sub>5</sub> ) <sub>2</sub>
2,4-Cl <sub>2</sub>	O	Cl	-OC≡N
2-CH <sub>3</sub> -4(2-Br-4-Cl)-C <sub>6</sub> H <sub>3</sub> O	NH	Cl	Cl
2-Cl	NH	Cl	CN
2,4-Cl <sub>2</sub>	O	Cl	-P(-O)(OC <sub>2</sub> H <sub>5</sub> ) <sub>2</sub>

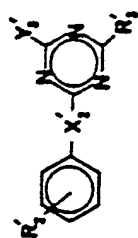
TABLE 2 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R'2	X'2	Y'1	R'3
2,4-Cl2	NH	Cl	CN
2,4-Cl2	O	F	CH3
3-C6H5O-	O	F	C2H5
3-NO2	NH	F	CH3
4-[-O-]	O	Cl	OCH2CF3
4-[-CH2O-]	O	Cl	CCl3
3-(n-C6H13)-	O	Cl	CN
3-[-CH2O-]	O	Cl	SO2CH3

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TABLE 2 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

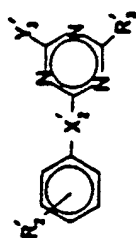


R'2	X'2	Y'3	R'3
4-(n-C <sub>7</sub> H <sub>15</sub> O)-	O	Cl	OSO <sub>2</sub> CH <sub>3</sub>
4-[C <sub>2</sub> H <sub>4</sub> O-C(=O)-O-C <sub>6</sub> H <sub>4</sub> -SO <sub>2</sub> ]	O	Cl	OCF <sub>3</sub>
4-[CH <sub>3</sub> O-C <sub>2</sub> H <sub>3</sub> (N)-O-C <sub>6</sub> H <sub>4</sub> -C(CH <sub>3</sub> ) <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> -O-C <sub>2</sub> H <sub>3</sub> (N)-CH <sub>3</sub> ]	O	Cl	OC <sub>2</sub> H <sub>5</sub>
3-[C <sub>6</sub> H <sub>4</sub> -CH <sub>2</sub> O-C <sub>6</sub> H <sub>3</sub> (Cl) <sub>2</sub> -C(CH <sub>3</sub> ) <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> ]	O	Cl	SC <sub>3</sub> H <sub>7</sub>
3-[C <sub>2</sub> H <sub>5</sub> C(=O)O-C <sub>6</sub> H <sub>4</sub> -C(CH <sub>3</sub> ) <sub>2</sub> -C <sub>6</sub> H <sub>4</sub> ]	S	F	OCH <sub>3</sub>

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TABLE 2 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



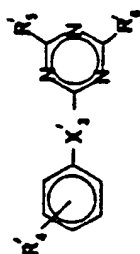
R'2	X'2	Y'3	R'3
3-[ $\alpha$ -C <sub>6</sub> H <sub>4</sub> S-C(=O)-C(=O)-C <sub>6</sub> H <sub>4</sub> -S-]	NH	OSO <sub>2</sub> CH <sub>3</sub>	CF <sub>3</sub>
3-[HC≡CCH <sub>2</sub> O-C(=O)-C <sub>6</sub> H <sub>4</sub> -S-]	NH	F	SC <sub>2</sub> H <sub>5</sub>
4-[C <sub>6</sub> H <sub>4</sub> NH-C(=O)-C <sub>6</sub> H <sub>4</sub> -NH-]	CCl <sub>2</sub>	Cl	SCH <sub>3</sub>
4-[Cl-C <sub>6</sub> H <sub>3</sub> (Cl)-CH <sub>2</sub> O-C(=O)-C <sub>6</sub> H <sub>4</sub> -S-]	S	F	CH <sub>2</sub> CHF <sub>2</sub>
3-[ $\alpha$ -C <sub>6</sub> H <sub>4</sub> O-C(=O)-C <sub>6</sub> H <sub>4</sub> -S-]	S	Cl	N(CH <sub>3</sub> ) <sub>3</sub> <sup>⊕</sup>
4-[CH <sub>2</sub> =CHCH <sub>2</sub> O-C(=O)-C <sub>6</sub> H <sub>4</sub> -NH-]	NH	F	OCF <sub>3</sub>
4-[Cl-C <sub>6</sub> H <sub>4</sub> -CH <sub>2</sub> O-C(=O)-C <sub>6</sub> H <sub>4</sub> -S-]	O	OSO <sub>2</sub> CF <sub>3</sub>	OSO <sub>2</sub> CF <sub>3</sub>





TABLE 3

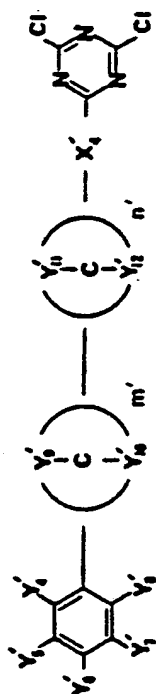
Representative Heterocyclic Nitrogen - Containing Compounds



R'4	X'3	R'5	R'6
2,4-Cl <sub>2</sub>	O	CN	CH <sub>3</sub>
2,4-Cl <sub>2</sub>	O	CN	H
2,4-Cl <sub>2</sub>	O	NO <sub>2</sub>	H
2,4-Cl <sub>2</sub>	O	COCH <sub>2</sub> Cl	H
2,4-Cl <sub>2</sub>	O	CN	CN
4-C <sub>6</sub> H <sub>5</sub> O	O	OCH <sub>2</sub> CF <sub>3</sub>	OCH <sub>2</sub> CF <sub>3</sub>
4-Cl	O	OCH <sub>2</sub> CF <sub>3</sub>	OCH <sub>2</sub> CF <sub>3</sub>
4-Br	S	OCF <sub>3</sub>	OCF <sub>3</sub>
2,3-(CH=CH-CH=CH)-	S	CCl <sub>3</sub>	CCl <sub>3</sub>
3,4-(CH <sub>2</sub> ) <sub>4</sub>	O	CF <sub>3</sub>	CF <sub>3</sub>
3,5-Cl <sub>2</sub>	O	OSO <sub>2</sub> CH <sub>3</sub>	OSO <sub>2</sub> CH <sub>3</sub>
3-NO <sub>2</sub>	O	OSO <sub>2</sub> CF <sub>3</sub>	OSO <sub>2</sub> CF <sub>3</sub>
3-C <sub>6</sub> H <sub>5</sub> CO	NH	OSO <sub>2</sub> CF <sub>3</sub>	OSO <sub>2</sub> CF <sub>3</sub>
3,4-(CH=CH-CH=CH)-	O	OSO <sub>2</sub> CH <sub>3</sub>	C <sub>2</sub> H <sub>5</sub>
4-CH <sub>3</sub> S	O	CN	OSO <sub>2</sub> CH <sub>3</sub>
4-C <sub>6</sub> H <sub>5</sub>	NH	OCOCH <sub>3</sub>	OCOCH <sub>3</sub>
3,4-Cl <sub>2</sub>	O	SO <sub>2</sub> CH <sub>3</sub>	SO <sub>2</sub> CH <sub>3</sub>

TABLE 4

Representative Heterocyclic Nitrogen - Containing Compounds

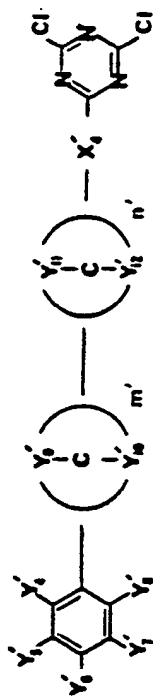


Y'4	Y'5	Y'6	Y'7	Y'8	m'	n'	Y'9	Y'10	Y'11	Y'12	K'4
H	H	H	H	H	0	1	-	-	H	H	0
Cl	H	Cl	H	H	0	1	-	-	H	H	0
Cl	H	H	H	H	0	1	-	-	H	H	0
H	Cl	H	H	H	0	1	-	-	H	H	0
H	H	Cl	H	H	0	1	-	-	H	H	0
H	Br	H	H	H	0	1	-	-	H	H	0
H	H	Br	H	H	0	1	-	-	H	H	0
F	H	H	H	H	0	1	-	-	H	H	0
H	F	H	H	H	0	1	-	-	H	H	0
H	H	F	H	H	0	1	-	-	H	H	0
H	H	I	H	H	0	1	-	-	H	H	0
H	Cl	Cl	H	H	0	1	-	-	H	H	0
H	Cl	H	Cl	H	0	1	-	-	H	H	0
Cl	H	H	H	Cl	0	1	-	-	H	H	0
F	H	Cl	H	H	0	1	-	-	H	H	0
H	H	CH <sub>3</sub>	H	H	0	1	-	-	H	H	0
H	CH <sub>3</sub>	H	H	H	0	1	-	-	H	H	0

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TABLE 4 (Cont.)

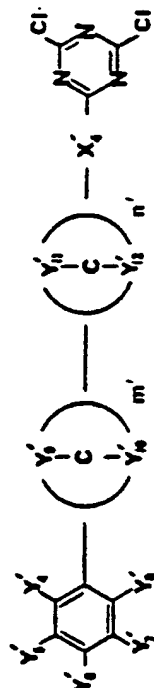
Representative Heterocyclic Nitrogen - Containing Compounds



Y'4	Y'5	Y'6	Y'7	Y'8	m'	n'	Y'9	Y'10	Y'11	Y'12	X'4
CH <sub>3</sub>	H	H	H	H	0	1	-	-	H	H	0
H	H	Isopropyl	H	H	0	1	-	-	H	H	0
H	H	t-butyl	H	H	0	1	-	-	H	H	0
OCH <sub>3</sub>	H	H	H	H	0	1	-	-	H	H	0
H	OCH <sub>3</sub>	H	H	H	0	1	-	-	H	H	0
H	H	OCH <sub>3</sub>	H	H	0	1	-	-	H	H	0
H	H	n-butyloxy	H	H	0	1	-	-	H	H	0
H	CF <sub>3</sub>	H	H	H	0	1	-	-	H	H	0
H	H	CF <sub>3</sub>	H	H	0	1	-	-	H	H	0
H	H	C <sub>2</sub> F <sub>5</sub>	H	H	0	1	-	-	H	H	0
H	OCF <sub>3</sub>	H	H	H	0	1	-	-	H	H	0
H	H	OCF <sub>3</sub>	H	H	0	1	-	-	H	H	0
H	H	OCF <sub>2</sub> H	H	H	0	1	-	-	H	H	0
H	OCF <sub>2</sub> H	H	H	H	0	1	-	-	H	H	0
H	NO <sub>2</sub>	H	H	H	0	1	-	-	H	H	0
H	H	NO <sub>2</sub>	H	H	0	1	-	-	H	H	0
H	CN	H	H	H	0	1	-	-	H	H	0

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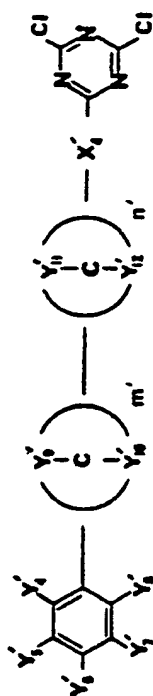
TABLE 4 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

													
Y'4-	Y'5-	Y'6-	Y'7-	Y'8-	m'	n'	Y'9-	Y'10-	Y'11-	Y'12-	X'4-		
H	H	CN	H	H	0	1	-	-	H	H	0		
H	SO <sub>2</sub> CH <sub>3</sub>	H	H	H	0	1	-	-	H	H	0		
H	H	SO <sub>2</sub> CH <sub>3</sub>	H	H	0	1	-	-	H	H	0		
H	H	SO <sub>2</sub> N(CH <sub>3</sub> ) <sub>2</sub>	H	H	0	1	-	-	H	H	0		
H	H	CO <sub>2</sub> CH <sub>3</sub>	H	H	0	1	-	-	H	H	0		
H	H	N(CH <sub>3</sub> ) <sub>2</sub>	H	H	0	1	-	-	H	H	0		
H	SCH <sub>3</sub>	H	H	H	0	1	-	-	H	H	0		
H	H	SCH <sub>3</sub>	H	H	0	1	-	-	H	H	0		
H	H	C <sub>6</sub> H <sub>5</sub> SO <sub>2</sub>	H	H	0	1	-	-	H	H	0		
H	H	CONHCH <sub>3</sub>	H	H	0	1	-	-	H	H	0		
H	H	OCOCH <sub>3</sub>	H	H	0	1	-	-	H	H	0		
H	H	OC <sub>6</sub> H <sub>5</sub>	H	H	0	1	-	-	H	H	0		
H	H	OCOCF <sub>3</sub>	H	H	0	1	-	-	H	H	0		
H	H	CON(CH <sub>3</sub> ) <sub>2</sub>	H	H	0	1	-	-	H	H	0		
Cl	H	Cl	H	H	0	1	-	-	H	CH <sub>3</sub>	0		
H	H	H	H	H	0	1	-	-	H	CH <sub>3</sub>	0		
H	H	Cl	H	H	0	1	-	-	H	CH <sub>3</sub>	0		

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TABLE 4 (Cont.)

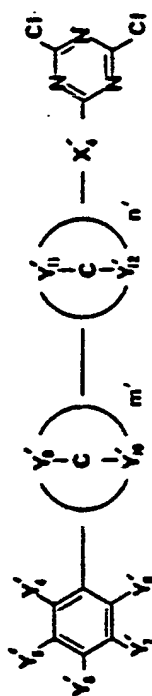
Representative Heterocyclic Nitrogen - Containing Compounds



Y'4-	Y'5-	Y'6-	Y'7-	Y'8-	m'	n'	Y'9-	Y'10-	Y'11-	Y'12-	X'4-
H	H	CN	H	H	0	1	-	-	H	CH <sub>3</sub>	0
H	H	NO <sub>2</sub>	H	H	0	1	-	-	H	CH <sub>3</sub>	0
H	H	CH <sub>3</sub>	H	H	0	1	-	-	H	CH <sub>3</sub>	0
H	H	CF <sub>3</sub>	H	H	0	1	-	-	H	CH <sub>3</sub>	0
H	H	OCF <sub>2</sub> H	H	H	0	1	-	-	H	CH <sub>3</sub>	0
H	H	OCF <sub>2</sub> Cl	H	H	0	1	-	-	H	CH <sub>3</sub>	0
H	H	OCH <sub>3</sub>	H	H	0	1	-	-	H	CH <sub>3</sub>	0
H	H	H	H	H	0	1	-	-	H	CH <sub>3</sub>	0
Cl	H	Cl	H	H	0	1	-	-	CH <sub>3</sub>	CH <sub>3</sub>	0
Cl	H	Cl	H	H	0	1	-	-	CH <sub>3</sub>	CH <sub>3</sub>	0
H	H	H	H	H	0	1	-	-	H	sec-butyl	0
H	H	H	H	H	0	1	-	-	H	CF <sub>3</sub>	0
H	H	Cl	H	H	0	1	-	-	H	CF <sub>3</sub>	0
Cl	H	Cl	H	H	0	1	-	-	H	CF <sub>3</sub>	0
Cl	H	F	H	H	0	1	-	-	H	CF <sub>3</sub>	0
H	H	CH <sub>3</sub>	H	H	0	1	-	-	H	CF <sub>3</sub>	0
H	NO <sub>2</sub>	H	H	H	0	1	-	-	H	CF <sub>3</sub>	0
H	H	NO <sub>2</sub>	H	H	0	1	-	-	H	CF <sub>3</sub>	0

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TABLE 4 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

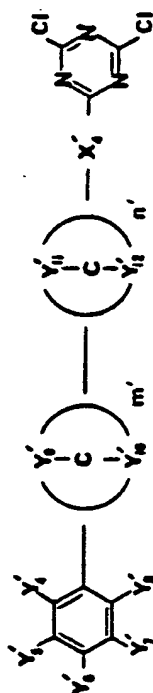


$\text{Y}'_4$ -	$\text{Y}'_5$ -	$\text{Y}'_6$ -	$\text{Y}'_7$ -	$\text{Y}'_8$ -	$\text{M}'$	$\text{N}'$	$\text{Y}'_9$ -	$\text{Y}'_{10}$ -	$\text{Y}'_{11}$ -	$\text{Y}'_{12}$ -	$\text{X}'_4$ -
H	CN	H	H	H	0	1	-	-	H	CF <sub>3</sub>	0
H	H	CN	H	H	0	1	-	-	H	CF <sub>3</sub>	0
H	H	SO <sub>2</sub> CH <sub>3</sub>	H	H	0	1	-	-	H	CF <sub>3</sub>	0
H	H	H	H	H	0	1	-	-	H	C <sub>2</sub> F <sub>5</sub>	0
Cl	H	Cl	H	H	0	1	-	-	H	C <sub>2</sub> F <sub>5</sub>	0
H	H	H	H	H	0	1	-	-	H	CH <sub>2</sub> CF <sub>3</sub>	0
Cl	H	Cl	H	H	0	1	-	-	H	CH <sub>2</sub> CF <sub>3</sub>	0
H	H	H	H	H	0	1	-	-	H	CN	0
Cl	H	Cl	H	H	0	1	-	-	H	CN	0
Cl	H	H	H	H	0	1	-	-	H	CN	0
H	Cl	H	H	H	0	1	-	-	H	CN	0
H	H	Cl	H	H	0	1	-	-	H	CN	0
H	Br	H	H	H	0	1	-	-	H	CN	0
H	H	Br	H	H	0	1	-	-	H	CN	0
H	Cl	Cl	H	H	0	1	-	-	H	CN	0
F	H	H	H	H	0	1	-	-	H	CN	0

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TABLE 4 (Cont.)

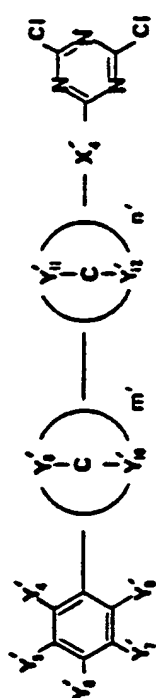
Representative Heterocyclic Nitrogen - Containing Compounds



$Y'4-$	$Y'5-$	$Y'6-$	$Y'7-$	$Y'8-$	$m'$	$n'$	$Y'9-$	$Y'10-$	$Y'11-$	$Y'12-$	$Y'13-$
H	F	H	H	H	0	1	-	-	H	CN	0
H	H	F	H	H	0	1	-	-	H	CN	0
H	CH <sub>3</sub>	H	H	H	0	1	-	-	H	CN	0
H	H	CH <sub>3</sub>	H	H	0	1	-	-	H	CN	0
H	H	Isopropyl	H	H	0	1	-	-	H	CN	0
H	H	t-butyl	H	H	0	1	-	-	H	CN	0
H	OCH <sub>3</sub>	H	H	H	0	1	-	-	H	CN	0
H	H	OCH <sub>3</sub>	H	H	0	1	-	-	H	CN	0
H	H	CF <sub>3</sub>	H	H	0	1	-	-	H	CN	0
H	H	OCF <sub>3</sub>	H	H	0	1	-	-	H	CN	0
H	H	OCF <sub>2</sub> H	H	H	0	1	-	-	H	CN	0
H	H	OCF <sub>2</sub> Cl	H	H	0	1	-	-	H	CN	0
H	H	SCH <sub>3</sub>	H	H	0	1	-	-	H	CN	0
H	H	0	H	H	0	1	-	-	H	CN	0
H	H	SCH <sub>3</sub>	H	H	0	1	-	-	H	CN	0
H	H	SO <sub>2</sub> CH <sub>3</sub>	H	H	0	1	-	-	H	CN	0
H	NO <sub>2</sub>	H	H	H	0	1	-	-	H	CN	0
H	H	NO <sub>2</sub>	H	H	0	1	-	-	H	CN	0

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TABLE 4 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



$\text{Y}'_4$ -	$\text{Y}'_5$ -	$\text{Y}'_6$ -	$\text{Y}'_7$ -	$\text{Y}'_8$ -	$\text{m}'$	$\text{n}'$	$\text{Y}'_9$ -	$\text{Y}'_{10}$ -	$\text{Y}'_{11}$ -	$\text{Y}'_{12}$ -	$\text{X}'_4$ -
H	CN	H	H	H	0	1	-	-	H	CN	0
H	H	CN	H	H	0	1	-	-	H	CN	0
H	H	H	H	H	0	1	-	-	CH <sub>3</sub>	CN	0
Cl	H	Cl	H	H	0	1	-	-	CH <sub>3</sub>	CN	0
H	H	H	H	H	0	1	-	-	C <sub>6</sub> H <sub>5</sub>	CN	0
Cl	H	Cl	H	H	0	1	-	-	C <sub>6</sub> H <sub>5</sub>	CN	0
H	H	H	H	H	1	1	H	H	H	CN	0
Cl	H	Cl	H	H	1	1	H	H	H	CN	0
H	H	H	H	H	1	1	H	H	H	H	0
Cl	H	Cl	H	H	1	1	H	H	H	H	0
H	H	H	H	H	1	1	H	H	H	H	0
H	H	NO <sub>2</sub>	H	H	1	1	H	H	H	H	0
H	H	CH <sub>3</sub>	H	H	1	1	H	H	H	H	0
H	H	OCH <sub>3</sub>	H	H	1	1	H	H	H	H	0
H	H	CF <sub>3</sub>	H	H	1	1	H	H	H	H	0
Cl	H	Cl	H	H	1	1	H	H	H	CH <sub>3</sub>	0
Cl	H	Cl	H	H	1	1	H	CH <sub>3</sub>	H	H	0
Cl	H	Cl	H	H	3	1	H	H	H	H	0



$$\begin{array}{c}
 \text{Cl} \\
 \diagup \quad \diagdown \\
 \text{C}_6\text{H}_2 \\
 \diagdown \quad \diagup \\
 \text{Cl}
 \end{array}
 - \text{X}^1 - \text{C}_6\text{H}_4 - \text{C}_6\text{H}_4 - \text{C}_6\text{H}_2 - \text{X}^2$$

$\frac{Y'_4}{-}$	$\frac{Y'_5}{-}$	$\frac{Y'_6}{-}$	$\frac{Y'_7}{-}$	$\frac{Y'_8}{-}$	$\frac{m'}{-}$	$\frac{n'}{-}$	$\frac{Y'_9}{-}$	$\frac{Y'_{10}}{-}$	$\frac{Y'_{11}}{-}$	$\frac{Y'_{12}}{-}$	$\frac{K'A}{-}$
C1	H	Cl	H	H	S	1	H	H	H	H	O
H	H	H	H	H	O	1	-	-	H	H	S
C1	H	Cl	H	H	O	1	-	-	H	H	S
H	H	Cl	H	H	O	1	-	-	H	H	S
H	H	CH <sub>3</sub>	H	H	O	1	-	-	H	H	S
H	H	OCH <sub>3</sub>	H	H	O	1	-	-	H	H	S
H	H	NO <sub>2</sub>	H	H	O	1	-	-	H	H	S
H	H	CN	H	H	O	1	-	-	H	H	S
H	H	N(CH <sub>3</sub> ) <sub>2</sub>	H	H	O	1	-	-	H	H	S
H	H	CF <sub>3</sub>	H	H	O	1	-	-	H	H	S
H	H	OCF <sub>2</sub> H	H	H	O	1	-	-	H	H	S
H	H	OCF <sub>2</sub> Cl	H	H	O	1	-	-	H	H	S
H	H	H	H	H	1	1	H	H	H	H	S
C1	H	Cl	H	H	1	1	H	H	H	H	S
H	H	H	H	H	O	1	H	H	H	CH <sub>3</sub>	S
C1	H	Cl	H	H	O	1	H	H	H	CH <sub>3</sub>	S
H	H	H	H	H	O	1	-	-	-	-	D.
H	H	H	H	H	O	1	-	-	H	H	S

TABLE 4 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

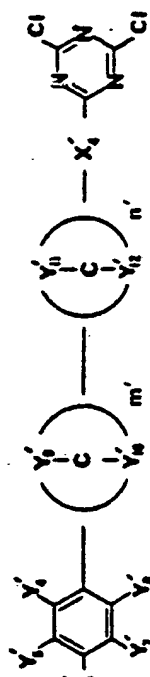
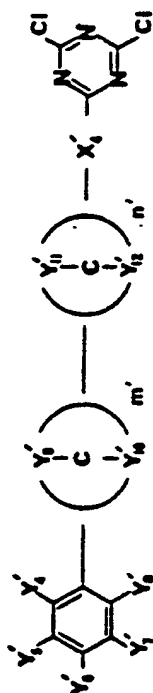
											
$\text{Y}'_4$	$\text{Y}'_5$	$\text{Y}'_6$	$\text{Y}'_7$	$\text{Y}'_8$	$\text{m}'$	$\text{n}'$	$\text{Y}'_9$	$\text{Y}'_{10}$	$\text{Y}'_{11}$	$\text{Y}'_{12}$	$\text{N}'_4$
Cl	H	Cl	H	H	0	1	-	-	H	H	0 : S
H	H	CH <sub>3</sub>	H	H	0	1	-	-	H	H	0 : S
H	H	OCH <sub>3</sub>	H	H	0	1	-	-	H	H	0 : S
H	H	CF <sub>3</sub>	H	H	0	1	-	-	H	H	0 : S
H	H	CN	H	H	0	1	-	-	H	H	0 : S
H	H	NO <sub>2</sub>	H	H	0	1	-	-	H	H	0 : S
H	H	N(CH <sub>3</sub> ) <sub>2</sub>	H	H	0	1	-	-	H	H	0 : S
H	H	H	H	H	0	1	-	-	H	H	SO <sub>2</sub>
Cl	H	Cl	H	H	0	1	-	-	H	H	SO <sub>2</sub>
H	H	CH <sub>3</sub>	H	H	0	1	-	-	H	H	SO <sub>2</sub>
H	H	OCH <sub>3</sub>	H	H	0	1	-	-	H	H	SO <sub>2</sub>

TABLE 4 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



<u>Y'4-</u>	<u>Y'5-</u>	<u>Y'6-</u>	<u>Y'7-</u>	<u>Y'8-</u>	<u>m'</u>	<u>n'</u>	<u>Y'9-</u>	<u>Y'10-</u>	<u>Y'11-</u>	<u>Y'12-</u>	<u>X'4-</u>
H	H	CF <sub>3</sub>	H	H	0	1	-	-	H	H	SO <sub>2</sub>
H	H	CN	H	H	0	1	-	-	H	H	SO <sub>2</sub>
H	H	NO <sub>2</sub>	H	H	0	1	-	-	H	H	SO <sub>2</sub>
H	H	N(CH <sub>3</sub> ) <sub>2</sub>	H	H	0	1	-	-	H	H	SO <sub>2</sub>
Cl	H	Cl	H	H	1	1	CH <sub>3</sub>	CH <sub>3</sub>	CH <sub>3</sub>	CH <sub>3</sub>	0
H	CF <sub>3</sub>	H	H	H	1	1	H	CH <sub>3</sub>	CH <sub>3</sub>	H	0
H	Br	H	Br	H	1	1	Cl	Cl	C <sub>2</sub> H <sub>5</sub>	H	0
H	H	H	H	H	0	1	-	-	H	H	Se
NO <sub>2</sub>	H	H	H	H	1	0	C <sub>2</sub> H <sub>5</sub>	H	-	-	Se

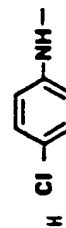
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TABLE 5

Representative Heterocyclic Nitrogen - Containing Compounds

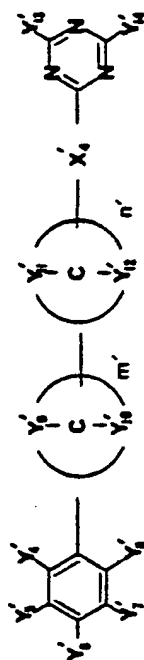


Y'4-	Y'5-	Y'6-	Y'7-	Y'8-	m'	n'	Y'9-	Y'10-	Y'11-	Y'12-	X'4-	Y'13-	Y'14-
Cl	H	Cl	H	H	0	0	-	-	-	-	SO <sub>2</sub>	Cl	Cl
H	CH <sub>3</sub>	CH <sub>3</sub>	CH <sub>3</sub>	H	0	0	-	-	-	-	SO <sub>2</sub>	Cl	Cl
-CH=CH-CH=CH-		Cl	H	H	0	0	-	-	-	-	SO <sub>2</sub>	Cl	Cl
-(CH <sub>2</sub> ) <sub>4</sub> -		H	H	H	0	0	-	-	-	-	SO <sub>2</sub>	Cl	Cl
H	H	C <sub>6</sub> H <sub>5</sub> CONH	H	H	0	0	-	-	-	-	SO <sub>2</sub>	Cl	Cl
H	-CH=CH-CH=CH-		H	H	0	0	-	-	-	-	SO <sub>2</sub>	Cl	Cl
Cl	H	Cl	H	H	0	0	-	-	-	-	SO <sub>2</sub>	I	I
H	4-ClC <sub>6</sub> H <sub>4</sub> O	H	H	H	0	0	-	-	-	-	SO <sub>2</sub>	I	I
H	4-ClC <sub>6</sub> H <sub>4</sub> O	H	H	CH <sub>3</sub>	0	0	-	-	-	-	SO <sub>2</sub>	Cl	CH <sub>3</sub> O
H	H	C <sub>6</sub> H <sub>5</sub>	H	H	0	0	-	-	-	-	SO <sub>2</sub>	Cl	CH <sub>3</sub>
H	C <sub>6</sub> H <sub>5</sub> O	C <sub>2</sub> H <sub>5</sub>	H	H	0	0	-	-	-	-	SO <sub>2</sub>	Cl	I
H	Cl	Cl	H	H	0	0	-	-	-	-	SO	Cl	Cl
-CH=CH-CH=CH-		CH <sub>3</sub>	H	H	0	0	-	-	-	-	SO	Cl	Cl
CH <sub>3</sub>	H	C <sub>6</sub> H <sub>5</sub> O	H	H	0	0	-	-	-	-	SO	Cl	Cl



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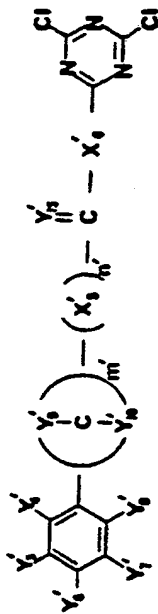
TABLE 5 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Y <sub>1</sub> -	Y <sub>2</sub> -	Y <sub>3</sub> -	Y <sub>4</sub> -	Y <sub>5</sub> -	Y <sub>6</sub> -	Y <sub>7</sub> -	Y <sub>8</sub> -	Y <sub>9</sub> -	Y <sub>10</sub> -	Y <sub>11</sub> -	Y <sub>12</sub> -	Y <sub>13</sub> -	Y <sub>14</sub> -
H	H	H	H	H	H	H	H	-	-	-	-	Cl	Cl
Cl	H	H	Br	H	Br	H	H	-	-	-	-	Cl	Cl
H	H	H	H	H	H	H	H	H	H	H	H	Cl	Cl
H	H	H	C <sub>6</sub> H <sub>5</sub> O	H	C <sub>6</sub> H <sub>5</sub> O	H	H	H	H	H	H	Cl	Cl
Cl	H	H	Cl	H	Cl	H	H	CH <sub>3</sub>	H	CH <sub>3</sub>	H	Cl	Cl
H	H	H	-O-CH <sub>2</sub> -O-	H	-O-CH <sub>2</sub> -O-	H	H	CH <sub>3</sub>	CH <sub>3</sub>	H	H	Cl	CH <sub>3</sub> O
H	C <sub>2</sub> H <sub>5</sub>	H	H	H	H	H	H	H	H	H	H	Cl	Cl
H	CH <sub>3</sub>	H	CH <sub>3</sub>	H	CH <sub>3</sub>	H	H	H	H	CH <sub>3</sub>	CH <sub>3</sub>	Cl	CH <sub>3</sub>
H	H	H	H	H	H	H	H	H	H	H	H	Cl	I
H	H	H	CH <sub>3</sub>	H	CH <sub>3</sub>	CH <sub>3</sub>	H	H	H	H	H	I	I
H	H	H	C <sub>6</sub> H <sub>5</sub>	H	C <sub>6</sub> H <sub>5</sub>	H	H	H	H	H	H	Cl	I
Cl	Br	Br	Br	Br	Br	H	H	CH <sub>3</sub>	H	H	H	Cl	Br

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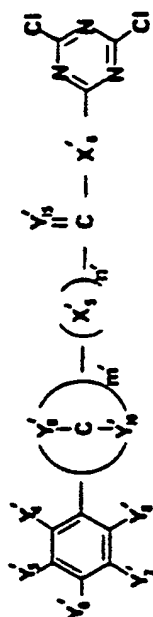
TABLE 6  
Representative Heterocyclic Nitrogen - Containing Compounds



$\frac{Y'_4}{-}$	$\frac{Y'_5}{-}$	$\frac{Y'_6}{-}$	$\frac{Y'_7}{-}$	$\frac{Y'_8}{-}$	$m'$	$\frac{n'}{-}$	$\frac{Y'_9}{-}$	$\frac{Y'_{10}}{-}$	$\frac{K'_5}{-}$	$\frac{Y'_{15}}{-}$	$\frac{K'_6}{-}$
H	H	H	H	H	O	O	-	-	-	O	S
H	H	C1	H	H	O	O	-	-	-	O	S
C1	H	C1	H	H	O	O	-	-	-	O	S
H	H	CH <sub>3</sub>	H	H	O	O	-	-	-	O	S
H	H	OCH <sub>3</sub>	H	H	O	O	-	-	-	O	S
H	H	CF <sub>3</sub>	H	H	O	O	-	-	-	O	S
H	H	NO <sub>2</sub>	H	H	O	O	-	-	-	O	S
H	H	CN	H	H	O	O	-	-	-	O	S
H	H	H	H	H	O	O	-	-	-	O	S
H	H	C1	H	H	O	O	-	-	-	S	S
C1	H	C1	H	H	O	O	-	-	-	S	S
H	H	CH <sub>3</sub>	H	H	O	O	-	-	-	S	S
H	H	OCH <sub>3</sub>	H	H	O	O	-	-	-	S	S
H	H	CF <sub>3</sub>	H	H	O	O	-	-	-	S	S
H	H	NO <sub>2</sub>	H	H	O	O	-	-	-	S	S
H	H	CN	H	H	O	O	-	-	-	S	S
H	H	H	H	H	O	1	-	-	O	S	S
H	H	C1	H	H	O	1	-	-	O	S	S

TABLE 6 (Cont.)

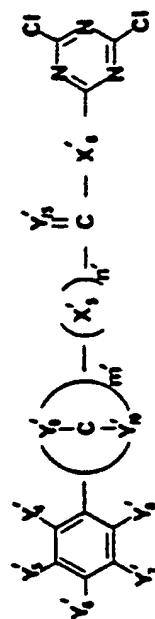
Representative Heterocyclic Nitrogen - Containing Compounds



Y' <sub>4</sub> -	Y' <sub>5</sub> -	Y' <sub>6</sub> -	Y' <sub>7</sub> -	Y' <sub>8</sub>	m'	n'	Y' <sub>9</sub> -	Y' <sub>10</sub> -	X' <sub>5</sub> -	Y' <sub>15</sub> -	X' <sub>6</sub> -
Cl	H	Cl	H	H	0	1	-	-	0	S	S
H	OCH <sub>3</sub>	H	H	H	0	1	-	-	0	S	S
H	H	CF <sub>3</sub>	H	H	0	1	-	-	0	S	S
H	H	NO <sub>2</sub>	H	H	0	1	-	-	0	S	S
H	H	CN	H	H	0	1	-	-	0	S	S
H	H	CH <sub>3</sub>	H	H	0	1	-	-	0	S	S
H	H	H	H	H	0	1	-	-	0	S	0
H	H	Cl	H	H	0	1	-	-	0	S	0
Cl	H	Cl	H	H	0	1	-	-	0	S	0
H	OCH <sub>3</sub>	H	H	H	0	1	-	-	0	S	0
H	H	CF <sub>3</sub>	H	H	0	1	-	-	0	S	0
H	NO <sub>2</sub>	H	H	H	0	1	-	-	0	S	0
H	NO <sub>2</sub>	H	H	H	0	1	-	-	0	S	0
H	CN	H	H	H	0	1	-	-	0	S	0
H	H	CH <sub>3</sub>	H	H	0	1	-	-	0	S	0
H	H	H	H	H	1	1	H	H	0	S	S
H	H	Cl	H	H	1	1	H	H	0	S	S
Cl	H	Cl	H	H	1	1	H	H	0	S	S

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TABLE 6 (Cont.)  
Representative Heterocyclic Nitroses - Containing Compounds



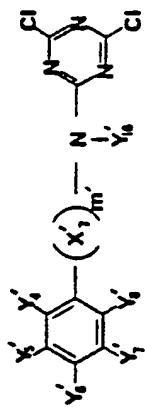
Y'4-	Y'5-	Y'6-	Y'7-	Y'8-	M'	N'	Y'9-	Y'10-	N'5-	Y'15-	N'6-
H	H	CH <sub>3</sub>	H	H	1	1	H	H	O	S	S
H	H	OCH <sub>3</sub>	H	H	1	1	H	H	O	S	S
H	H	CF <sub>3</sub>	H	H	1	1	H	H	O	S	S
H	NO <sub>2</sub>	H	H	H	1	1	H	H	O	S	S
H	CN	H	H	H	1	1	H	H	O	S	S
H	H	H	H	H	0	1	-	-	NH	S	S
H	H	Cl	H	H	0	1	-	-	NH	S	S
Cl	H	Cl	H	H	0	1	-	-	NH	S	S
H	H	CH <sub>3</sub>	H	H	0	1	-	-	NH	S	S
H	H	OCH <sub>3</sub>	H	H	0	1	-	-	NH	S	S
H	NO <sub>2</sub>	H	H	H	0	1	-	-	NH	S	S
H	CN	H	H	H	0	1	-	-	NH	S	S
H	H	H	H	H	0	1	-	-	O	0	0
H	H	C <sub>6</sub> H <sub>5</sub> O	H	H	0	1	-	-	O	0	0

SUBSTITUTE SHEET



TABLE 7

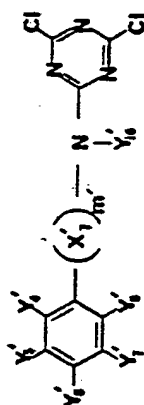
Representative Heterocyclic Nitrogen - Containing Compounds



Y'4-	Y'5-	Y'6-	Y'7-	Y'8-	m'	X'7-	Y'16-
H	H	H	H	H	1	CO	H
H	H	Cl	H	H	1	CO	H
Cl	H	Cl	H	H	1	CO	H
H	Cl	Cl	H	H	1	CO	H
H	Cl	H	H	H	1	CO	H
H	Br	H	H	H	1	CO	H
H	H	Br	H	H	1	CO	H
H	F	F	H	H	1	CO	H
H	H	I	H	H	1	CO	H
F	H	Cl	H	H	1	CO	H
H	H	CH <sub>3</sub>	H	H	1	CO	H
H	CH <sub>3</sub>	H	H	H	1	CO	H
CH <sub>3</sub>	H	H	H	H	1	CO	H
H	H	Isopropyl	H	H	1	CO	H
H	H	t-butyl	H	H	1	CO	H
OCH <sub>3</sub>	H	H	H	H	1	CO	H
H	OCH <sub>3</sub>	H	H	H	1	CO	H
H	H	OCH <sub>3</sub>	H	H	1	CO	H

TABLE 7 (Cont.)

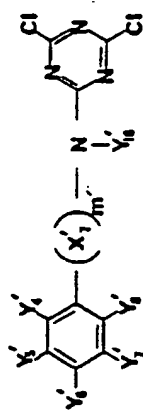
Representative Heterocyclic Nitrogen - Containing Compounds



Y' <sub>4</sub> -	Y' <sub>5</sub> -	Y' <sub>6</sub> -	Y' <sub>7</sub> -	Y' <sub>8</sub> -	m'	X' <sub>7</sub> -	Y' <sub>16</sub> -
H	CF <sub>3</sub>	H	H	H	1	CO	H
H	H	CF <sub>3</sub>	H	H	1	CO	H
H	OCF <sub>3</sub>	H	H	H	1	CO	H
H	H	OCF <sub>3</sub>	H	H	1	CO	H
H	H	OCF <sub>2</sub> H	H	H	1	CO	H
H	H	OCF <sub>2</sub> Cl	H	H	1	CO	H
H	NO <sub>2</sub>	H	H	H	1	CO	H
H	H	NO <sub>2</sub>	H	H	1	CO	H
H	CN	H	H	H	1	CO	H
H	H	CN	H	H	1	CO	H
H	H	SO <sub>2</sub> CH <sub>3</sub>	H	H	1	CO	H
H	H	SO <sub>2</sub> N(CH <sub>3</sub> ) <sub>2</sub>	H	H	1	CO	H
H	H	SCH <sub>3</sub>	H	H	1	CO	H
H	H	H	H	H	1	CO	CH <sub>3</sub>
H	H	Cl	H	H	1	CO	CH <sub>3</sub>
Cl	H	Cl	H	H	1	CO	CH <sub>3</sub>
H	H	CH <sub>3</sub>	H	H	1	CO	CH <sub>3</sub>
H	H	OCH <sub>3</sub>	H	H	1	CO	CH <sub>3</sub>

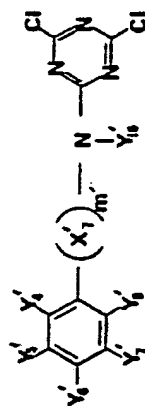
TABLE 7 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



Y'4-	Y'5-	Y'6-	Y'7-	Y'8-	m'	Y'7-	Y'16-
H	NO <sub>2</sub>	H	H	H	1	CO	CH <sub>3</sub>
H	CN	H	H	H	1	CO	CH <sub>3</sub>
H	H	CF <sub>3</sub>	H	H	1	CO	CH <sub>3</sub>
H	H	H	H	H	0	-	COCH <sub>3</sub>
H	H	Cl	H	H	0	-	COCH <sub>3</sub>
Cl	H	Cl	H	H	0	-	COCH <sub>3</sub>
H	Cl	H	H	H	0	-	COCH <sub>3</sub>
H	H	OCH <sub>3</sub>	H	H	0	-	COCH <sub>3</sub>
H	CH <sub>3</sub>	H	H	H	0	-	COCH <sub>3</sub>
H	H	CH <sub>3</sub>	H	H	0	-	COCH <sub>3</sub>
H	H	SCH <sub>3</sub>	H	H	0	-	COCH <sub>3</sub>
H	H	CF <sub>3</sub>	H	H	0	-	COCH <sub>3</sub>
H	H	OCF <sub>2</sub> H	H	H	0	-	COCH <sub>3</sub>
H	H	OCF <sub>2</sub> Cl	H	H	0	-	COCH <sub>3</sub>
H	NO <sub>2</sub>	H	H	H	0	-	COCH <sub>3</sub>
H	CN	H	H	H	0	-	COCH <sub>3</sub>
H	H	H	H	H	0	-	COCH <sub>3</sub>
Cl	H	Cl	H	H	0	-	COCH <sub>3</sub>

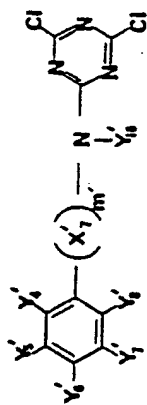
TABLE 7 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Y <sub>1</sub> '- H	Y <sub>2</sub> '- H	Y <sub>3</sub> '- H	Y <sub>4</sub> '- H	Y <sub>5</sub> '- H	Y <sub>6</sub> '- H	Y <sub>7</sub> '- H	Y <sub>8</sub> '- H	m'	X <sub>1</sub> '- CS	Y <sub>16</sub> '- H
Cl	H	Cl	H	H	Cl	H	H	1	CS	H
H	H	H	H	H	H	H	H	1	CS	H
H	H	H	H	H	Cl	H	H	1	SO <sub>2</sub>	H
H	H	H	H	H	Cl	H	H	1	SO <sub>2</sub>	H
Cl	H	Cl	H	H	Cl	H	H	1	SO <sub>2</sub>	H
CO <sub>2</sub> CH <sub>3</sub>	H	H	H	H	H	H	H	1	SO <sub>2</sub>	H
H	H	CH <sub>3</sub>	H	H	CH <sub>3</sub>	H	H	1	SO <sub>2</sub>	H
H	H	OCH <sub>3</sub>	H	H	OCH <sub>3</sub>	H	H	1	SO <sub>2</sub>	H
H	OCH <sub>3</sub>	H	H	H	H	H	H	1	SO <sub>2</sub>	H
NO <sub>2</sub>	H	H	H	H	H	H	H	1	SO <sub>2</sub>	H
H	CN	H	H	H	H	H	H	1	SO <sub>2</sub>	H
H	H	H	CF <sub>3</sub>	H	CF <sub>3</sub>	H	H	1	SO <sub>2</sub>	H
H	H	H	H	H	H	H	H	0	-	SO <sub>2</sub> CH <sub>3</sub>
H	H	H	Cl	H	Cl	H	H	0	-	SO <sub>2</sub> CH <sub>3</sub>
Cl	H	H	Cl	H	Cl	H	H	0	-	SO <sub>2</sub> CH <sub>3</sub>
H	H	H	CH <sub>3</sub>	H	CH <sub>3</sub>	H	H	0	-	SO <sub>2</sub> CH <sub>3</sub>
H	H	H	OCH <sub>3</sub>	H	OCH <sub>3</sub>	H	H	0	-	SO <sub>2</sub> CH <sub>3</sub>
H	H	H	CF <sub>3</sub>	H	CF <sub>3</sub>	H	H	0	-	SO <sub>2</sub> CH <sub>3</sub>

TABLE 7 (Cont.)

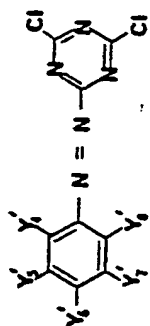
Representative Heterocyclic Nitrogen - Containing Compounds



$\underline{Y'4-}$	$\underline{Y'5-}$	$\underline{Y'6-}$	$\underline{Y'7-}$	$\underline{Y'8-}$	$\underline{m'}$	$\underline{X'7-}$	$\underline{Y'16-}$
H	NO <sub>2</sub>	H	H	H	0	-	SO <sub>2</sub> CH <sub>3</sub>
H	CN	H	H	H	0	-	SO <sub>2</sub> CH <sub>3</sub>
H	H	NO <sub>2</sub>	H	H	0	-	SO <sub>2</sub> CH <sub>3</sub>
H	H	H	H	H	0	-	SO <sub>2</sub> CF <sub>3</sub>
Cl	H	Cl	H	H	0	-	SO <sub>2</sub> CF <sub>3</sub>
H	Cl	H	Cl	H	0	-	SO <sub>2</sub> CH <sub>3</sub>

TABLE B

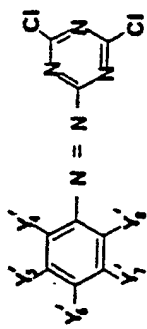
Representative Heterocyclic Nitrogen - Containing Compounds



Y'4-	Y'5-	Y'6-	Y'7-	Y'8-
H	H	H	H	H
H	H	Cl	H	H
Cl	H	Cl	H	H
H	Cl	H	H	H
H	Cl	Cl	H	H
H	H	Br	H	H
H	H	F	H	H
H	H	CF <sub>3</sub>	H	H
H	H	CH <sub>3</sub>	H	H
H	OCH <sub>3</sub>	H	H	H
H	H	OCH <sub>3</sub>	H	H
H	H	SCH <sub>3</sub>	H	H
H	NO <sub>2</sub>	H	H	H
H	H	NO <sub>2</sub>	H	H
H	CN	H	H	H
		O		
H	H	SCH <sub>3</sub>	H	H

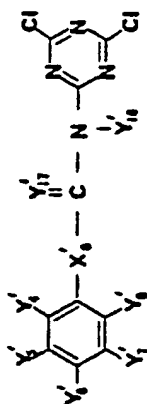
TABLE 8 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



$Y'4-$	$Y'5-$	$Y'6-$	$Y'7-$	$Y'8-$
H	H	SO <sub>2</sub> CH <sub>3</sub>	H	H
H	H	N(CH <sub>3</sub> ) <sub>2</sub>	H	H
H	H	CO <sub>2</sub> CH <sub>3</sub>	H	H
OH	H	H	CH <sub>3</sub>	H

TABLE 9  
Representative Heterocyclic Nitrogen - Containing Compounds



Y <sub>4</sub> -	Y <sub>5</sub> -	Y <sub>6</sub> -	Y <sub>7</sub> -	Y <sub>8</sub> -	X <sub>6</sub> -	Y <sub>17</sub> -	Y <sub>18</sub> -
H	H	H	H	H	NH	O	H
H	H	Cl	H	H	NH	O	H
Cl	H	Cl	H	H	NH	O	H
H	H	CH <sub>3</sub>	H	H	NH	O	H
H	H	OCH <sub>3</sub>	H	H	NH	O	H
H	H	CF <sub>3</sub>	H	H	NH	O	H
H	H	SCH <sub>3</sub>	H	H	NH	O	H
H	H	SO <sub>2</sub> CH <sub>3</sub>	H	H	NH	O	H
H	H	H	H	H	NH	S	H
Cl	H	Cl	H	H	NH	S	H
H	H	H	H	H	O	O	H
Cl	H	Cl	H	H	O	O	H
H	H	CH <sub>3</sub>	H	H	O	O	H
H	H	OCH <sub>3</sub>	H	H	O	O	H
H	H	CF <sub>3</sub>	H	H	O	O	H
H	NO <sub>2</sub>	H	H	H	O	O	H
H	CN	H	H	H	O	O	H
H	H	H	H	H	O	S	H



TABLE 9 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

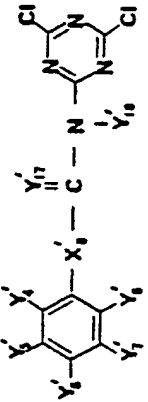
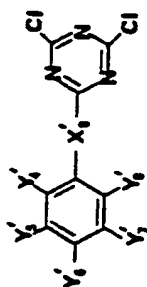
							
Y <sub>1</sub> -	Y <sub>2</sub> -	Y <sub>3</sub> -	Y <sub>4</sub> -	Y <sub>5</sub> -	Y <sub>6</sub> -	Y <sub>7</sub> -	Y <sub>8</sub> -
Cl	H	H	H	H	Cl	H	H
H	H	H	H	H	C <sub>6</sub> H <sub>5</sub> O	H	H
						S	H
						O	H

TABLE 10

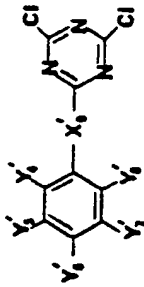
Representative Heterocyclic Nitrogen - Containing Compounds



Y' <sub>4</sub> -	Y' <sub>5</sub> -	Y' <sub>6</sub> -	Y' <sub>7</sub> -	Y' <sub>8</sub> -	X' <sub>6</sub> -
H	H	H	H	H	single bond
Cl	H	Cl	H	H	single bond
Cl	H	H	H	H	single bond
H	Cl	H	H	H	single bond
H	H	Cl	H	H	single bond
H	H	Br	H	H	single bond
F	H	H	H	H	single bond
H	F	H	H	H	single bond
H	H	F	H	H	single bond
H	H	I	H	H	single bond
CH <sub>3</sub>	H	H	H	H	single bond
H	CH <sub>3</sub>	H	H	H	single bond
H	H	CH <sub>3</sub>	H	H	single bond
H	H	Isopropyl	H	H	single bond
H	H	t-butyl	H	H	single bond
OCH <sub>3</sub>	H	H	H	H	single bond
H	OCH <sub>3</sub>	H	H	H	single bond
H	H	OCH <sub>3</sub>	H	H	single bond

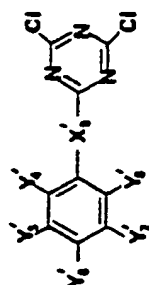
TABLE 10 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



Y'4-	Y'5-	Y'6-	Y'7-	Y'8-	Y'9-
H	CF <sub>3</sub>	H	H	H	single bond
H	H	CF <sub>3</sub>	H	H	single bond
H	H	OCF <sub>2</sub> H	H	H	single bond
H	H	OCF <sub>2</sub> Cl	H	H	single bond
Cl	Cl	Cl	Cl	Cl	single bond
F	F	F	F	F	single bond
H	NO <sub>2</sub>	H	H	H	single bond
H	H	NO <sub>2</sub>	H	H	single bond
H	CN	H	H	H	single bond
H	H	CN	H	H	single bond
H	H	SOCH <sub>3</sub>	H	H	single bond
H	H	SO <sub>2</sub> CH <sub>3</sub>	H	H	single bond
H	H	N(CH <sub>3</sub> ) <sub>2</sub>	H	H	single bond
H	H	CO <sub>2</sub> CH <sub>3</sub>	H	H	single bond
H	H	H	H	H	CH <sub>2</sub>
Cl	H	Cl	H	H	CH <sub>2</sub>
H	Cl	H	H	H	CH <sub>2</sub>
H	Cl	Cl	H	H	CH <sub>2</sub>

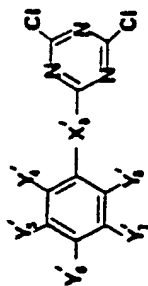
TABLE 10 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Y'4-	Y'5-	Y'6-	Y'7-	Y'8-	X'9-
H	H	Br	H	H	CH <sub>2</sub>
H	F	H	H	H	CH <sub>2</sub>
H	H	F	H	H	CH <sub>2</sub>
F	H	Cl	H	H	CH <sub>2</sub>
H	NO <sub>2</sub>	H	H	H	CH <sub>2</sub>
H	CN	H	H	H	CH <sub>2</sub>
H	H	OCH <sub>3</sub>	H	H	CH <sub>2</sub>
H	CH <sub>3</sub>	H	H	H	CH <sub>2</sub>
H	H	CH <sub>3</sub>	H	H	CH <sub>2</sub>
H	H	SCH <sub>3</sub>	H	H	CH <sub>2</sub>
H	H	SO <sub>2</sub> CH <sub>3</sub>	H	H	CH <sub>2</sub>
H	H	N(CH <sub>3</sub> ) <sub>2</sub>	H	H	CH <sub>2</sub>
H	H	H	H	H	CHCN
H	H	Cl	H	H	CHCN
Cl	H	Cl	H	H	CHCN
H	H	CH <sub>3</sub>	H	H	CHCN
H	H	OCH <sub>3</sub>	H	H	CHCN
H	H	NO <sub>2</sub>	H	H	CHCN

TABLE 1D (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds

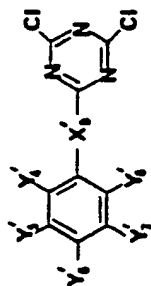


Y' <sub>4</sub> -	Y' <sub>5</sub> -	Y' <sub>6</sub> -	Y' <sub>7</sub> -	Y' <sub>8</sub> -	Y' <sub>9</sub> -
H	H	CN	H	H	CHCN
H	H	CF <sub>3</sub>	H	H	CHCN
H	H	H	H	H	CHCO <sub>2</sub> CH <sub>3</sub>
Cl	H	Cl	H	H	CHCO <sub>2</sub> CH <sub>3</sub>
H	H	H	H	H	-C≡C-
H	H	Cl	H	H	-C≡C-
Cl	H	Cl	H	H	-C≡C-
H	H	CH <sub>3</sub>	H	H	-C≡C-
H	H	OCH <sub>3</sub>	H	H	-C≡C-
H	H	CF <sub>3</sub>	H	H	-C≡C-
H	NO <sub>2</sub>	H	H	H	-C≡C-
H	CN	H	H	H	-C≡C-
H	H	H	H	H	-CH=CH-
H	H	Cl	H	H	-CH=CH-
Cl	H	Cl	H	H	-CH=CH-
H	H	CF <sub>3</sub>	H	H	-CH=CH-
H	H	CH <sub>3</sub>	H	H	-CH=CH-
H	H	OCH <sub>3</sub>	H	H	-CH=CH-



TABLE 10 (Cont.)

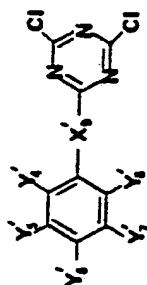
Representative Heterocyclic Nitrogen - Containing Compounds



Y' <sub>4</sub> -	Y' <sub>5</sub> -	Y' <sub>6</sub> -	Y' <sub>7</sub> -	Y' <sub>8</sub> -	X' <sub>9</sub> -
H	H	Cl	H	H	$\begin{array}{c} \text{O} \\   \\ \text{CH}_2\text{C}- \end{array}$
Cl	H	Cl	H	H	$\begin{array}{c} \text{O} \\   \\ \text{CH}_2\text{C}- \end{array}$
H	H	CH <sub>3</sub>	H	H	$\begin{array}{c} \text{O} \\   \\ \text{CH}_2\text{C}- \end{array}$
H	H	OCH <sub>3</sub>	H	H	$\begin{array}{c} \text{O} \\   \\ \text{CH}_2\text{C}- \end{array}$
H	H	H	H	H	$\begin{array}{c} \text{O} \\   \\ \text{CCH}_2- \end{array}$
H	H	Cl	H	H	$\begin{array}{c} \text{O} \\   \\ \text{CCH}_2- \end{array}$
Cl	H	Cl	H	H	$\begin{array}{c} \text{O} \\   \\ \text{CCH}_2- \end{array}$
H	H	CH <sub>3</sub>	H	H	$\begin{array}{c} \text{O} \\   \\ \text{CCH}_2- \end{array}$
H	H	OCH <sub>3</sub>	H	H	$\begin{array}{c} \text{O} \\   \\ \text{CCH}_2- \end{array}$

TABLE 10 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds

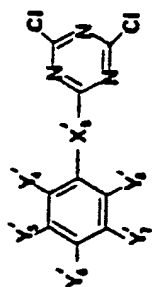


Y'4-	Y'5-	Y'6-	Y'7-	Y'8-	Y'9-
H	H	OC <sub>6</sub> H <sub>5</sub>	H	H	-C(CH <sub>3</sub> ) <sub>2</sub> -
Br	H	Br	H	H	-CH(C <sub>2</sub> H <sub>5</sub> )-
H	H	-O-CH <sub>2</sub> -O-		H	-C(Cl) <sub>2</sub> -
H	H	-O-CH <sub>2</sub> -O-		H	O O O
Cl	H	Cl	H	H	-C-C-
H	H	H	H	H	O O O
-CH-CH-CH-CH-	H	H	H	H	-S-CH <sub>2</sub> -
H	-CH-CH-CH-CH-	H	H	H	O
H	NO <sub>2</sub>	H	H	H	single bond
H	H	C <sub>6</sub> H <sub>5</sub> O-	H	H	single bond
H	C <sub>6</sub> H <sub>5</sub> O-	H	H	H	single bond
H	H	C <sub>6</sub> H <sub>5</sub>	H	H	single bond
H	H	C <sub>6</sub> H <sub>5</sub>	H	H	single bond



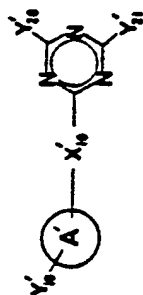
TABLE 10 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



$\underline{Y'4-}$	$\underline{Y'5-}$	$\underline{Y'6-}$	$\underline{Y'7-}$	$\underline{Y'8-}$	$\underline{Y'9-}$
$C_6H_5-$	H	H	H	H	single bond
$-CH=CH-CH=CH-$		$C_2H_5O$	H	H	single bond
H	H	$CH_3$	H	H	single bond
H	Cl	Cl	H	H	single bond

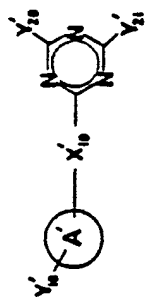
TABLE 11  
Representative Heterocyclic Nitrogen - Containing Compounds



$Y'_{19}$	$A'$	$X'_{10}$	$Y'_{20}$	$Y'_{21}$
H	phenyl	$-C(CH_3)_2-NO_2$	Cl	Cl
2,6-Cl <sub>2</sub>	phenyl	$-CH_2-NO_2$	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	$-CH_2-NO_2$	Cl	Cl
4-NO <sub>2</sub>	phenyl	$-CH_2-NO_2$	Cl	Cl
2-CH <sub>3</sub> O-4-C <sub>5</sub> H <sub>11</sub> O	phenyl	$-CH_2-NO_2$	Cl	Cl
4-Cl	phenyl	$-COCH_2-NO_2$	Cl	Cl
H	phenyl	$-CH_2CONHCH_2CH_2-NO_2$	Cl	Cl
4-Cl	phenyl	$-SCH_2C(CH_3)_2-NO_2$	Cl	Cl
4-Cl	phenyl	$-SO_2CH_2C(CH_3)_2-NO_2$	Cl	Cl
H	phenyl	Se	Cl	Cl
2,4-Cl	phenyl	Se	Cl	Cl
4-Br	phenyl	Se	Cl	Cl
2-Cl-5-CN	phenyl	$-PO(OCH_3)_2$	Cl	Cl
3,4-(CH <sub>3</sub> ) <sub>2</sub>	phenyl	$-PH(=O)-$	F	F
H	phenyl	$-O-PO(OCH_3)_2$	Cl	Cl
H	phenyl	$-Si(CH_3)_2-$	Cl	Cl
4-C <sub>6</sub> H <sub>5</sub> CONH-	phenyl	$-NH-SO_2-$	Cl	Cl
H	4-chloro-1-naphthyl	$-NH-SO_2$	Cl	SC <sub>2</sub> H <sub>5</sub>

TABLE II (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



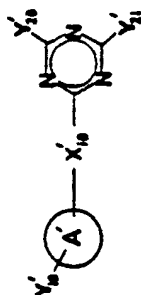
Y'19-	A'	X'10-	Y'20-	Y'21-
4-Cl	phenyl	-C≡C-	F	F
2,4-Cl	phenyl	-C≡C-	F	OCH <sub>3</sub>
H	phenyl	-C≡C-	Cl	OCH <sub>2</sub> CF <sub>3</sub>
H	2-pyridinyl	-C≡C-	Cl	Cl
3-NO <sub>2</sub>	2-pyridinyl	-CH=CH-(cis)	Cl	Cl
3-NO <sub>2</sub>	2-pyridinyl	-CH=CH-(trans)	Cl	Cl
5-Cl		-CH <sub>2</sub> CH <sub>2</sub> -	F	CN
3,4-Cl <sub>2</sub>	phenyl		Cl	Cl
2,5-(CH <sub>3</sub> ) <sub>2</sub>	phenyl		Cl	Cl
3,4,5-(CH <sub>3</sub> ) <sub>3</sub>	phenyl	-CO-	Cl	OC <sub>6</sub> H <sub>5</sub>
3-Cl	phenyl	-CO-	I	I

TABLE 11 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

Y'19-	A'	X'10-	Y'20-	Y'21-
		-CH2CO-	Br	I
		-COCH2	F	I
5-C6H5O-	1-naphthyl	-NHO-	Cl	Cl
2,4-Cl2	phenyl	-S-S-	Cl	Cl
H	phenyl	-S-S-	Cl	Cl
2-F-3-Cl	phenyl	-S-S-	Cl	Cl
2,3-(CH=CHCH=CH)-	phenyl	single bond	Cl	CN
3-NO2	phenyl	single bond	Cl	CN
4-C6H5	phenyl	single bond	Cl	CN
2-Cl	phenyl	single bond	Cl	-C=CH
H	phenyl	single bond	Cl	CCl3
2,3-(CH=CHCH=CH)-	phenyl	single bond	Cl	CH3SO2O-

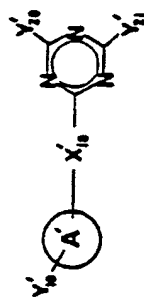
TABLE 11 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



Y'19-	A'	X'10-	Y'20-	Y'21-
3,4,5-(CH <sub>3</sub> ) <sub>3</sub>	phenyl	single bond	Cl	CH <sub>3</sub> SO <sub>2</sub> O-
H	phenyl	single bond	Cl	CF <sub>3</sub> CH <sub>2</sub> O
2-C <sub>6</sub> H <sub>5</sub>	phenyl	single bond	F	F
2,3-(CH-CHCH-CH)-	phenyl	single bond	Cl	-SO <sub>3</sub> C <sub>6</sub> H <sub>4</sub> O
4-CH <sub>3</sub>	phenyl	-SO <sub>2</sub> NHCONH-	Cl	Cl
2-Cl	phenyl	-SO <sub>2</sub> NHCONH-	Cl	Cl
3,4-Cl <sub>2</sub>	phenyl		Cl	Cl
3-C <sub>6</sub> H <sub>5</sub>	phenyl		Cl	Cl
3-NO <sub>2</sub>	phenyl	-CH <sub>2</sub> COCH <sub>2</sub> -	Cl	Cl
4-C <sub>6</sub> H <sub>5</sub> O	phenyl	-CH <sub>2</sub> COCH <sub>2</sub> -	Cl	Cl

TABLE 11 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Y'19-	A'	A'10-	Y'20-	Y'21-
2,4-Cl <sub>2</sub>	phenyl		Cl	Cl
4-Cl	phenyl		Cl	Cl
H	phenyl	single bond	OCH <sub>2</sub> CF <sub>3</sub>	OCH <sub>2</sub> CF <sub>3</sub>
H	1-naphthyl	single bond	OSO <sub>2</sub> CH <sub>3</sub>	OSO <sub>2</sub> CH <sub>3</sub>
H	1-naphthyl	single bond	CH <sub>3</sub>	CN
H	phenyl	-C≡C-	OCH <sub>2</sub> CF <sub>3</sub>	OCH <sub>2</sub> CF <sub>3</sub>
H	1-naphthyl	single bond	CN	CN
3-C <sub>6</sub> H <sub>5</sub>	phenyl	single bond	CN	H
H	phenyl	-CH <sub>2</sub> N-CHC≡C-	Cl	Cl
H	phenyl	-CH <sub>2</sub> NHCH <sub>2</sub> C≡C-	Cl	Cl

TABLE II (Cont.)

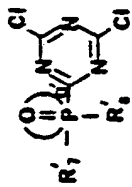
Representative Heterocyclic Nitrogen - Containing Compounds



Y'19-	A'	X'10-	Y'20-	Y'21-
H	phenyl	$\begin{array}{c} \text{CH}_3 \\   \\ -\text{CH}_2\text{NCH}_2\text{C}\equiv\text{C}- \end{array}$	Cl	Cl
H	phenyl	$\begin{array}{c} \text{CH}_3 \\   \\ -\text{NH}-\text{C}-\text{N}- \end{array}$	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	-OCH <sub>2</sub> CH <sub>2</sub> O-	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	-OCH <sub>2</sub> -	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	-OCH(CH <sub>3</sub> )-	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	-OC(CH <sub>3</sub> ) <sub>2</sub> -	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	-OCH <sub>2</sub> O-	Cl	Cl

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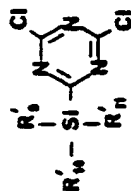
TABLE 12  
Representative Heterocyclic Nitrogen-Containing Compounds



R <sub>7</sub> -	R <sub>8</sub> -	R <sub>9</sub> -
OCH <sub>3</sub>	OCH <sub>3</sub>	1
OCH <sub>2</sub> CH <sub>3</sub>	OCH <sub>2</sub> CH <sub>3</sub>	1
phenyl	OCH <sub>3</sub>	1
phenyl	phenyl	0



TABLE 13

Representative Heterocyclic Nitrogen-Containing Compounds

<u>R'9-</u>	<u>R'10-</u>	<u>R'11-</u>
CH <sub>3</sub>	CH <sub>3</sub>	CH <sub>3</sub>
CH <sub>3</sub>	CH <sub>3</sub>	t-butyl
phenyl	CH <sub>3</sub>	CH <sub>3</sub>

TABLE 14  
Representative Heterocyclic Nitrogen - Containing Compounds

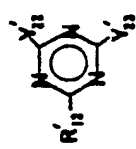

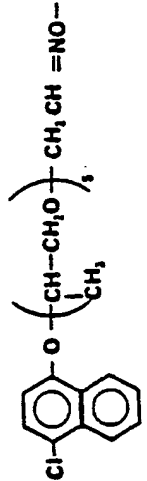
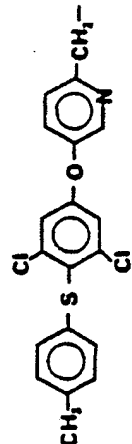
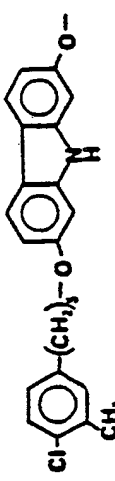
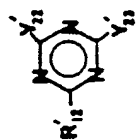
		Y'22-	Y'23-
R'12-		Cl	CN
CH <sub>3</sub> (CH <sub>2</sub> ) <sub>18</sub> CF <sub>2</sub> CF <sub>2</sub> O-		Cl	OCH <sub>2</sub> CF <sub>3</sub>
CH <sub>3</sub> O-(CH <sub>2</sub> CH <sub>2</sub> O) <sub>7</sub> CH <sub>2</sub> C≡C-			
	F		SCH <sub>3</sub>
	Cl		CCl <sub>3</sub>
	F		OC <sub>2</sub> H <sub>5</sub>
	Cl		OCF <sub>3</sub>

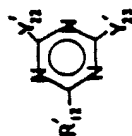
TABLE 14 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



$R'_{12}$ -	$Y'_{12}$ -	$Y'_{13}$ -
 <chem>ClC1=CC=CC=C1S2C=CC=CC=C2S3C=CC=CC=C3S4</chem>	$OSO_2CH_3$	$OSO_2CH_3$
 <chem>Clc1ccc(Oc2ccc(CS(=O)(=O)N)cc2)cc1Cl</chem>	Cl	$OCH_2CF_3$
 <chem>Nc1nc2ccccc2o1-c3ccccc3</chem>	F	$OCH_3$
 <chem>COc1ccc(cc1)-c2ccc(cc2)C#C-</chem>	Cl	$CF_3$
 <chem>Clc1ccc(cc1)-c2ccc(cc2)Oc3cc4ccccc4n3</chem>	Cl	$CH_3SO_2$

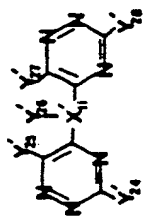
TABLE 14 (Cont.)  
Representative Heterocyclic Nitrogen-Containing Compounds



$R'_{12}$ -	$Y'_{22}$ -	$Y'_{23}$ -
	Cl	Cl
	Cl	Cl

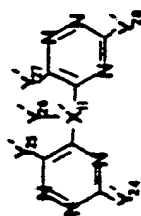
TABLE 15

Representative Heterocyclic Nitrogen - Containing Compounds



Y'24-	Y'25-	X'11-	Y'26-	Y'27-	Y'28-
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl			--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl

TABLE 15 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

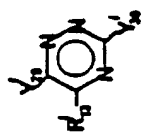


$Y'_{24}-$	$Y'_{25}-$	$X'_{11}-$	$Y'_{26}-$	$Y'_{27}-$	$Y'_{28}-$
Cl	Cl		---	Cl	Cl
Cl	Cl	N	H	Cl	Cl
Cl	Cl	N	CH <sub>3</sub> CO	Cl	Cl
Cl	Cl	N		Cl	Cl
Cl	Cl	N	CH <sub>3</sub> SO <sub>2</sub> -	Cl	Cl
Cl	Cl	S	---	Cl	Cl
Cl	Cl	-S-S-	---	Cl	Cl
Cl	Cl	-NH-NH-	---	Cl	Cl
Cl	Cl	-N=N-	---	Cl	Cl
Cl	Cl	single bond	---	Cl	Cl
Cl	Cl	O	---	Cl	Cl
Cl	Cl	-CH=CH-	---	Cl	Cl

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TABLE 16  
Representative Heterocyclic Nitrogen - Containing Compounds

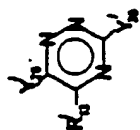


$R'_{13}$	$Y'_{29}$	$Y'_{30}$
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl



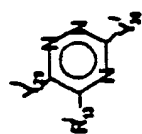
TABLE 16 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



R <sup>13</sup> -	Y <sup>29</sup> -	Y <sup>30</sup> -
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl

TABLE 16 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



$R_{13}$	$R_{14}$	$R_{15}$
	Cl	$OCH_2CF_3$
	CN	CN
	$OSO_2CH_3$	$OSO_2CH_3$
	$CCl_3$	$CCl_3$
	$CH_3S$	Cl

TABLE 16 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

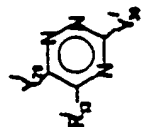

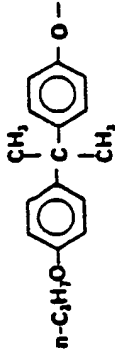

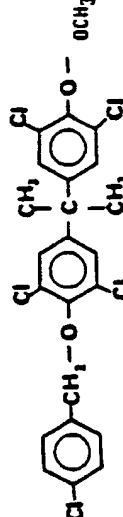
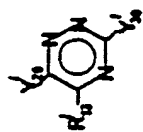
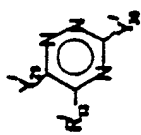
	Y'29-	Y'30-
R'13-		
	C <sub>2</sub> H <sub>5</sub> SO <sub>2</sub>	Br
	F	F
	F	I
	F	F

TABLE 16 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



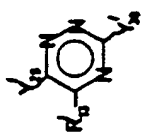
R <sub>13</sub> -	Y <sub>129</sub> -	Y <sub>130</sub> -
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl

TABLE 16 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



$R_{13}$	$Y_{29}$	$Y_{30}$
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl

TABLE 16 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



$R'_{13}$ -	$Y'_{29}$ -	$Y'_{30}$ -
 <chem>Clc1cc(C#C)cc(Cl)c1</chem>	Cl	Cl
$C_2H_5O-C\equiv C-$	Cl	Cl
$HC\equiv C-$	Cl	Cl
 <chem>O=Cc1ccccc1</chem>	Cl	Cl
 <chem>O=Cc1ccc(Cl)cc1</chem>	Cl	Cl
 <chem>ClS(=O)(=O)c1ccc(Cl)cc1</chem>	Cl	Cl

TABLE 16 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

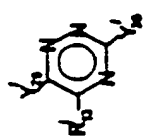
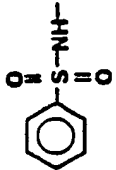
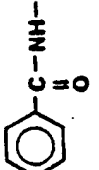
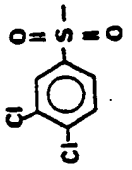

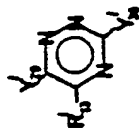
		Y <sub>29</sub> -	Y <sub>30</sub> -
R <sub>13</sub> -		Cl	Cl
		Cl	Cl
		Cl	Cl
		Cl	Cl

TABLE 16 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

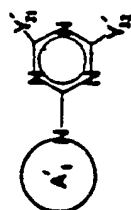


R <sup>13</sup> -	Y <sup>29</sup> -	Y <sup>30</sup> -
Cl <sub>2</sub> CH-O-	Cl	Cl
CCl <sub>3</sub>	Cl	Cl
-CH-CHCN	Cl	Cl
-CH-CHCOCH <sub>3</sub>	Cl	Cl
-CH-CHCO <sub>2</sub> C <sub>2</sub> H <sub>5</sub>	Cl	Cl
-CO <sub>2</sub> C <sub>6</sub> H <sub>5</sub>	Cl	Cl
-NHCO <sub>2</sub> N <sub>3</sub>	Cl	Cl
CH <sub>3</sub> SO <sub>2</sub> NH-	Cl	Cl
-CH <sub>2</sub> CN	Cl	Cl



TABLE 17

Representative Heterocyclic Nitrogen - Containing Compounds



A'1-	Y'31-	Y'32-
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl

TABLE 17 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

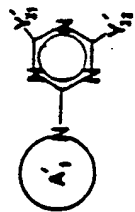
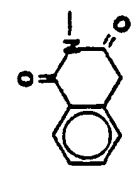
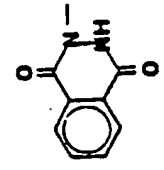
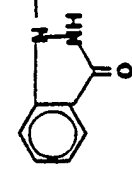
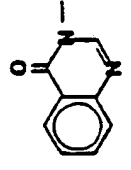
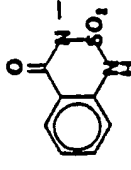
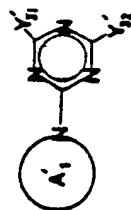
A <sub>1</sub> -		Y' <sub>31</sub> -	Y' <sub>32</sub> -
		Cl	Cl
		Cl	Cl
		Cl	Cl
		Cl	Cl
		Cl	Cl

TABLE 17 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



A'1-	Y'31-	Y'32-
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl

TABLE 17 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

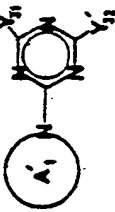
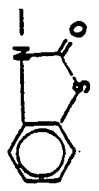
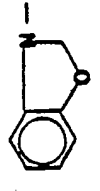
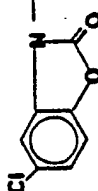
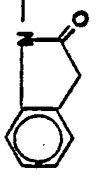
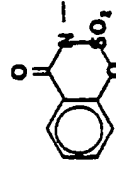
			
A'1-	Y'31-	Y'32-	
	Cl	Cl	
	Cl	Cl	
	Cl	Cl	
	Cl	Cl	
	Cl	Cl	

TABLE 17 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

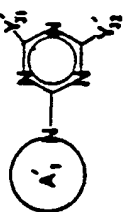

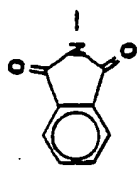
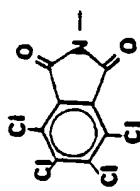
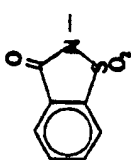
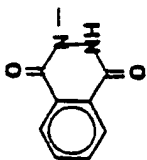
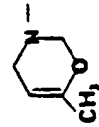
	Y <sub>11</sub> -		Y <sub>12</sub> -		Y <sub>13</sub> -	
						
	Cl	Cl	Cl	Cl	Cl	Cl

TABLE 17 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

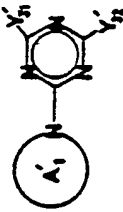
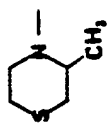


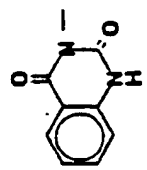
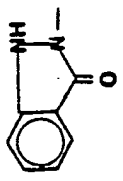
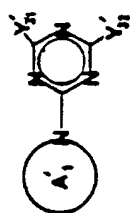
A <sub>1</sub> -		Y <sub>1</sub> -31-	Y <sub>1</sub> -32-
		Cl	Cl
		Cl	Cl
		Cl	Cl
		Cl	Cl
		Cl	Cl
		Cl	Cl

TABLE 17 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



$A'_1$ -	$Y'_{31}$ -	$Y'_{32}$ -
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl

TABLE 17 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

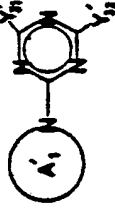

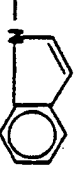


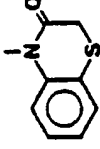
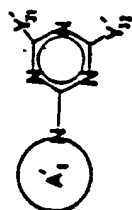
	Y'31-		Y'32-	
	A'1-			
		Cl	Cl	
		Cl	Cl	
		Cl	Cl	
		Cl	Cl	
		Cl	Cl	



TABLE 17 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



$A_1$	$Y_{31}$ - Cl	$Y_{32}$ - Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl
	Cl	Cl

TABLE 1B  
Representative Heterocyclic Nitrogen - Containing Compounds

A <sub>12</sub> -	X <sub>12</sub> - single bond	Y <sub>33</sub> -	Y <sub>34</sub> -	Chemical Structure
2-pyridinyl		Cl	Cl	
3-pyridinyl	O	Cl	Cl	
	O	Cl	Cl	
	NH	Cl	Cl	
	NH	Cl	Cl	
	O	Cl	Cl	
		Cl	Cl	

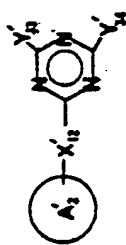
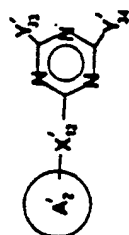


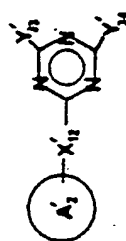
TABLE 18 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



A'2-	X'12-	Y'33-	Y'34-
		Cl	Cl
	single bond	Cl	Cl
	single bond	Cl	Cl
	single bond	Cl	Cl
	single bond	Cl	Cl
	single bond	Cl	Cl
	NH	Cl	Cl

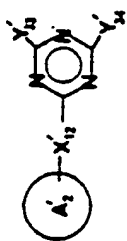
TABLE 1B (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



A'2-	X'12-	Y'33-	Y'34-
	NH	Cl	Cl
	NH	Cl	Cl
	single bond	Cl	Cl
	O	Cl	Cl
	O	Cl	Cl
	NH	Cl	Cl
	O	Cl	Cl

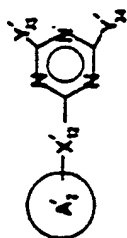
TABLE 1B (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



A'2-	X'12-	Y'13-	Y'14-
	0	Cl	Cl
	0	Cl	Cl
	0	Cl	Cl
	0	Cl	Cl
	0	Cl	Cl
	0	Cl	Cl
	0	Cl	Cl

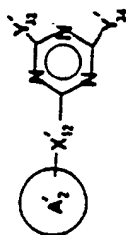
TABLE 18 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



	X'12-	Y'13-	Y'14-
	O	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl

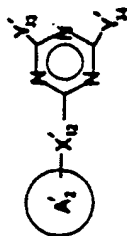
TABLE 1B (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



A'2-	X'12-	Y'13-	Y'14-
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl

TABLE 1A (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



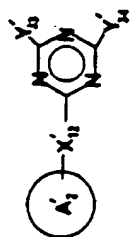
A12-	Xa	Y10	Y11	Y12
	NH	Cl	Cl	Cl
	NH	Cl	Cl	Cl
	NH	Cl	Cl	Cl
	NH	Cl	Cl	Cl
	NH	Cl	Cl	Cl
	single bond	Cl	Cl	Cl
	single bond	Cl	Cl	Cl

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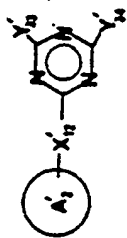
TABLE 18 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



$A_1$ -	$X'_{12}$ -	$Y'_{13}$ -	$Y'_{14}$ -
	single bond	Cl	Cl
	single bond	Cl	Cl
	single bond	Cl	Cl
	single bond	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl

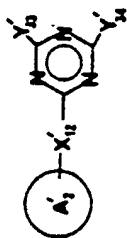
TABLE 10 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



A'2-	A'12-	Y'33-	Y'34-
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl

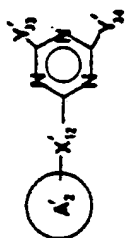
TABLE 1B (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



A'2-	X'12-	Y'13-	Y'14-
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl

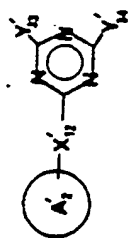
TABLE 1B (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds:



A'12-	X'12-	Y'33-	Y'34-
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	O	Cl	Cl
	O	Cl	Cl
	O	Cl	Cl
	O	Cl	Cl

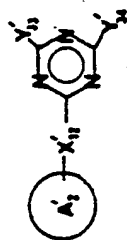
TABLE 1B (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



A'2-	A'12-	Y'33-	Y'34-
	0	Cl	Cl
	single bond	Cl	Cl
	single bond	Cl	Cl
	single bond	Cl	Cl
	single bond	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl

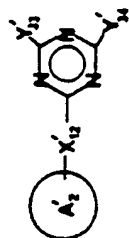
TABLE 1B (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



A'2-	A'12-	Y'13-	Y'14-
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	O	Cl	Cl
	O	Cl	Cl

TABLE 1B (Cont.)

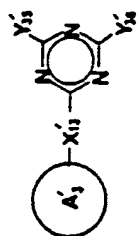
Representative Heterocyclic Nitrogen - Containing Compounds



	A'2-	Y'13-	Y'14-
	O	Cl	Cl
	O	Cl	Cl
	NH	Cl	Cl
	CH2	Cl	Cl
	O	Cl	Cl
	O	Cl	Cl
	CH2	Cl	Cl

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TABLE 19  
Representative Heterocyclic Nitrogen - Containing Compounds



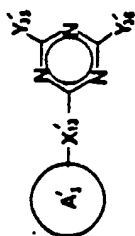
A'3-	X'13-	Y'35-	Y'36-
	O	Cl	Cl
	NH	Cl	Cl
	NH	Cl	Cl
	O	Cl	Cl
	S	Cl	Cl
	SO2	Cl	Cl
	S	Cl	Cl

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TABLE 19 (Cont.)

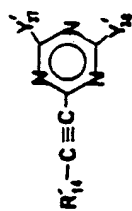
Representative Heterocyclic Nitrogen - Containing Compounds





$A'_{13}$	$X'_{13}$	$Y'_{15}$	$Y'_{16}$
	NH	Cl	Cl
	O	Cl	Cl
	NH	Cl	Cl
	O	Cl	Cl
	O	Cl	Cl
	NH	Cl	Cl
	O	Cl	Cl

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TABLE 20  
Representative Heterocyclic Nitrogen - Containing Compounds

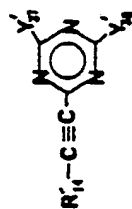


$R'_{14}$ -	$Y'_{37}$ -	$Y'_{38}$ -
$(CH_3)_3Si$	Cl	Cl
$C_2H_5O-$	Cl	Cl
$CH_3O-C-$ O	Cl	Cl
$CH_3NH-CH(CH_3)-$	Cl	Cl
$(CH_3)_2C(OH)-$	Cl	Cl
	Cl	Cl
	Cl	Cl
$CH_2-CH-O-$	Cl	Cl
$(CH_3)_2NCH_2-$	Cl	Cl
$(CH_3)_3SiOCH_2-$	Cl	Cl

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TABLE 20 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

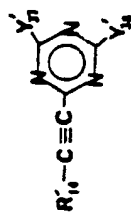


$R'_{14}$	$Y'_{37}$	$Y'_{38}$
$HO(CH_2)_2-$	Cl	Cl
$C_2H_5CH(OH)-$	Cl	Cl
$CH_3(CH_2)_4CH(OH)-$	Cl	Cl
	Cl	Cl
	Cl	Cl
$H_2NCH_2-$	Cl	Cl
$(CH_3)_2NCH_2-$	Cl	Cl
$(C_2H_5)_2NCH_2-$	Cl	Cl
$HC=CCCH_2-NH-CH_2-$	Cl	Cl
$(HC=CCCH_2)_2N-CH_2-$	Cl	Cl
$\begin{matrix} O \\    \\ CH_3-C- \end{matrix}$	Cl	Cl

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TABLE 2D (Cont.)

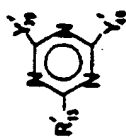
Representative Heterocyclic Nitrogen - Containing Compounds



$\text{R}'_{14}-$	$\text{Y}'_{37}-$	$\text{Y}'_{38}-$
$\text{HO}_2\text{C}-$	Cl	Cl
$\text{C}_2\text{H}_5\text{O}-\text{C}-$ O	Cl	Cl
H	Cl	Cl
n-C <sub>3</sub> H <sub>7</sub> -	Cl	Cl
(CH <sub>3</sub> ) <sub>3</sub> C-	Cl	Cl

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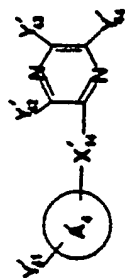
TABLE 21  
Representative Heterocyclic Nitrogen - Containing Compounds




R'15-	Y'39-	Y'40-
-SH	Cl	Cl
-N-CCl <sub>2</sub>	Cl	Cl
-SCH <sub>3</sub>	Cl	Cl
-CH-NOH	Cl	Cl
-NHCOCF <sub>3</sub>	Cl	Cl
-NHCOCH <sub>3</sub>	Cl	Cl
-CONH <sub>2</sub>	Cl	Cl
-CH <sub>2</sub> CN	Cl	Cl
-CH=CHCN	Cl	Cl
-CH=CHCOCH <sub>3</sub>	Cl	Cl
-CH=CHCO <sub>2</sub> CH <sub>3</sub>	Cl	Cl
-OCOC <sub>6</sub> H <sub>5</sub>	Cl	Cl
-NHCO <sub>2</sub> C <sub>6</sub> H <sub>5</sub>	Cl	Cl
-N(CH <sub>2</sub> Cl) <sub>2</sub>	Cl	Cl
CH <sub>3</sub> SO <sub>2</sub> NH-	Cl	Cl
(CH <sub>3</sub> ) <sub>2</sub> N-	Cl	Cl
(CH <sub>3</sub> ) <sub>2</sub> N-	Cl	(CH <sub>3</sub> ) <sub>2</sub> N-
(CH <sub>3</sub> ) <sub>2</sub> CHO-	Br	Br
(CH <sub>3</sub> ) <sub>2</sub> C=NO-	Cl	Cl

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TABLE 22  
Representative Heterocyclic Nitrogen - Containing Compounds

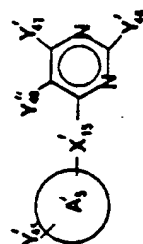


Y'1-	A'4-	X'14-	Y'12-	Y'13-	Y'14-
2,4-Cl	phenyl	O	H	H	Cl
2,4-Cl	phenyl	O	Cl	H	H
2,4-Cl	phenyl	O	H	Cl	H
3,5-Cl	phenyl	S	H	H	Cl
2-CH3-4- C6H4O-	phenyl	S	Cl	H	Cl
5-C6H5O-		O	H	F	F
4-C6H5-	phenyl	O	H	Br	Br
4-Cl	phenyl	O	F	-CH=CHCH=CH-	
2,4-Cl2	phenyl	O	Cl	-CH=CH-CH=CH-	
H	phenyl	O	Cl	Cl	Cl

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TABLE 23

Representative Heterocyclic Nitrogen - Containing Compounds:



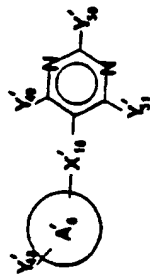
Y'45-	A'5-	X'15-	Y'46-	Y'47-	Y'48-
2,4-Cl <sub>2</sub>	phenyl	O	Cl	H	H
2,4-Cl <sub>2</sub>	phenyl	O	Cl	CH <sub>3</sub>	H
2,4-Cl <sub>2</sub>	phenyl	O	Cl	Cl	H
3,5-Cl <sub>2</sub>	phenyl	O	F	F	H
4-Cl	phenyl	S	Cl	Cl	H
3,4-Cl <sub>2</sub>	phenyl	O	Br	Br	H
3,5-Cl <sub>2</sub>	phenyl	O	Cl	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	O	Cl	Cl	Cl
H	1-naphthyl	O	Cl	Cl	Cl
4-C <sub>6</sub> H <sub>5</sub> O-	phenyl	S	Cl	Cl	Cl
H	phenyl	O	Cl	Cl	Cl

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TABLE 24

Representative Heterocyclic Nitrogen - Containing Compounds

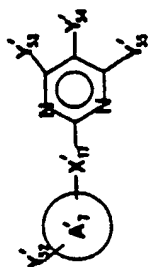


<u>Y'48-</u>	<u>A'6-</u>	<u>X'16-</u>	<u>Y'49-</u>	<u>Y'50-</u>	<u>Y'51-</u>
3,5-Cl <sub>2</sub>	phenyl	O	Cl	Cl	Cl
4-NO <sub>2</sub>	phenyl	O	Cl	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	O	Cl	Cl	Cl
4-NO <sub>2</sub>	phenyl	O	F	F	F
4-NO <sub>2</sub>	phenyl	O	Br	Br	Br
3-C <sub>6</sub> H <sub>5</sub> O-	phenyl	S	Cl	Cl	Cl
H	phenyl	CH <sub>2</sub>	Cl	Cl	CH <sub>3</sub>

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TABLE 25  
Representative Heterocyclic Nitrogen - Containing Compounds

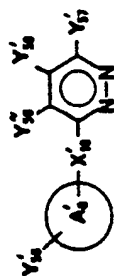


Y'52-	A'1-	K'17-	Y'53-	Y'54-	Y'55-
4-[CH <sub>3</sub> CH(CO <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub> )-]	phenyl	O	Cl	H	Cl
H	phenyl	-CH <sub>2</sub> CH <sub>2</sub> -	Cl	Cl	Cl
H	phenyl	O	Cl	Cl	Cl

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TABLE 26

Representative Heterocyclic Nitrogen - Containing Compounds

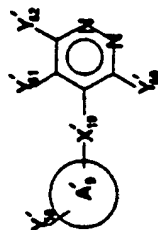


Y'56-	A'8-	X'10-	Y'57-	Y'58-	Y'59-
3-Cl	phenyl	O	Cl	H	H
2,4-Cl <sub>2</sub>	phenyl	O	Cl	H	H
3,4-Cl <sub>2</sub>	phenyl	O	Cl	Cl	H
4-Cl	phenyl	S	Cl	Cl	Cl
3,4-(CH <sub>3</sub> ) <sub>2</sub>	phenyl	O	F	F	F
H	1-naphthyl	O	Br	Br	Br
2,4-Cl <sub>2</sub>	phenyl	O	Cl	Cl	H

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TABLE 21

Representative Heterocyclic Nitrogen - Containing Compounds









<u>Y'59-</u>	<u>A'9-</u>	<u>X'19-</u>	<u>Y'60-</u>	<u>Y'61-</u>	<u>Y'62-</u>
2,4-Cl <sub>2</sub>	phenyl	O	Cl	H	Cl
4-Cl-C <sub>6</sub> H <sub>4</sub> O-	phenyl	O	H	Cl	Cl
2-CH <sub>3</sub> -4-Cl	phenyl	S	Cl	H	Cl

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TABLE 2B

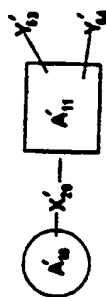
## Representative Heterocyclic Nitrogen - Containing Compounds



A'10=A'20-	A'11-	Y'63-	Y'64-
4-(4'-ClC <sub>6</sub> H <sub>4</sub> O-)		3-Cl	5-Cl
4-(3',4'-Br <sub>2</sub> C <sub>6</sub> H <sub>3</sub> NH-)		5-F	3-H
3-(2',4'-Cl <sub>2</sub> C <sub>6</sub> H <sub>4</sub> -)		5-Cl	4-CCl <sub>3</sub>
1-(4'-O <sub>2</sub> N-C <sub>6</sub> H <sub>5</sub> -)		3,5-Cl <sub>2</sub>	4-H
4-(2'-naphthoxy-)		3,5-F <sub>2</sub>	1-CH <sub>3</sub>
1-[4'-C <sub>6</sub> H <sub>5</sub> O-C <sub>6</sub> H <sub>4</sub> O-]		3,4,5-Cl <sub>3</sub>	-

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TABLE 28 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



A'10-A'20-	A'11-	Y'63-	Y'64-
4-(C <sub>6</sub> H <sub>5</sub> O-C <sub>6</sub> H <sub>4</sub> O-)		2,5-Cl <sub>2</sub>	-
4-C <sub>6</sub> H <sub>5</sub> -		2,5-F <sub>2</sub>	-
4-(4'-Cl-C <sub>6</sub> H <sub>4</sub> -)		2-F	5-H
5-(3'-C <sub>6</sub> H <sub>5</sub> O-C <sub>6</sub> H <sub>4</sub> -)		2,4-Cl <sub>2</sub>	-
4-(4'-Cl-C <sub>6</sub> H <sub>4</sub> -)		2-F	5-H
4-[3-C <sub>6</sub> H <sub>5</sub> (CH <sub>2</sub> ) <sub>3</sub> -]		2,5-Cl <sub>2</sub>	-

TABLE 28 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



A'10-X'20-	A'11-	Y'63-	Y'54-
5-[3-O <sub>2</sub> NC <sub>6</sub> H <sub>4</sub> -]		2-Cl	4-NO <sub>2</sub>
4-C <sub>6</sub> H <sub>5</sub>		2,5-Cl <sub>2</sub>	1-C <sub>2</sub> H <sub>5</sub>
5-[3',4'-Cl <sub>2</sub> C <sub>6</sub> H <sub>3</sub> O-]		2-F	4-CCl <sub>3</sub> -1-H-
4-[4'-Cl-C <sub>6</sub> H <sub>4</sub> CH-CH-]		2,5-Cl <sub>2</sub>	1-H
5-[3-Cl-		3-Cl	1-H
5-(C <sub>6</sub> H <sub>5</sub> CO-)		3-Cl	1-CH <sub>3</sub>

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TABLE 2B (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



A'10-A'20-	A'11-	Y'63-	Y'64-
1-(C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> -)		3,5-F <sub>2</sub>	-
3-(4-Cl-C <sub>6</sub> H <sub>4</sub> -)		5-F	-
3-(1-naphthoxy)		5-Cl	-
2-(2',4'-Cl <sub>2</sub> -C <sub>6</sub> H <sub>3</sub> O-)		5-F	-
2-[3',4'-(O <sub>2</sub> N) <sub>2</sub> C <sub>6</sub> H <sub>3</sub> -]		5-F	-
3-[3',5'-Cl <sub>2</sub> -C <sub>6</sub> H <sub>3</sub> -S-]		5-F	-



TABLE 2B (Cont.)

## Representative Heterocyclic Nitrogen - Containing Compounds



$A'_{10}-X'_{10}-$	$A'_{11}-$	$Y'_{11}-$	$Y'_{10}-$
3-C <sub>6</sub> H <sub>5</sub> CO-		5-Cl	-
2-[1-naphthyl-C-]		5-F	-
2-[4'-C <sub>6</sub> H <sub>5</sub> C-]		5-Br	-
2-[3'-O <sub>2</sub> N-C <sub>6</sub> H <sub>4</sub> S-]		5-Cl	-
5-[		3-F	-
6-[3'-BrC <sub>6</sub> H <sub>4</sub> O-]		3-F	-

TABLE 2B (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



A'10-X'20-	A'11-	Y'63-	Y'64-
4-(C <sub>6</sub> H <sub>5</sub> S-)		2-Cl	1-H- 5,7-(NO <sub>2</sub> ) <sub>2</sub>
6-(3',4'-Cl <sub>2</sub> C <sub>6</sub> H <sub>3</sub> -)		2-F	4,5,7-H <sub>3</sub>
6-(4'-C <sub>6</sub> H <sub>5</sub> -C <sub>6</sub> H <sub>4</sub> -)		2-Cl	5-NO <sub>2</sub>
4-(C <sub>6</sub> H <sub>5</sub> O-)		2-F	6-CH <sub>3</sub> SO <sub>2</sub>
4-(4'-NO <sub>2</sub> C <sub>6</sub> H <sub>4</sub> O-)		2-Cl	5,6,7-H <sub>3</sub>
7-(3',4',5'-Cl <sub>3</sub> -C <sub>6</sub> H <sub>2</sub> CH <sub>2</sub> -)		2-F	4,5,6-H <sub>3</sub>

TABLE 2B (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



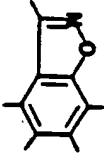
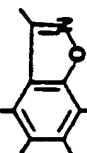

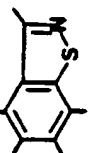
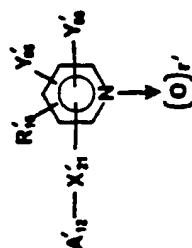
$A'_{10} = X'_{10} -$	$A'_{11} -$	$Y'_{11} -$	$Y'_{14} -$
5-C <sub>6</sub> H <sub>5</sub> -		3-Cl	4,6,7-H <sub>3</sub>
5-[2',4'-Cl <sub>2</sub> C <sub>6</sub> H <sub>3</sub> -]		3-F	4,6,7-H <sub>3</sub>
6-C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> -		3-Cl	4-NO <sub>2</sub> -5,7-H <sub>2</sub>
7-[4'-C <sub>6</sub> H <sub>5</sub> -C <sub>6</sub> H <sub>4</sub> ]		3-F	4,5,6-H <sub>3</sub>

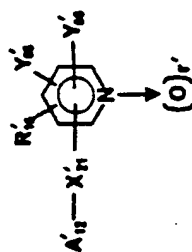
TABLE 29

Representative Heterocyclic Nitrogen - Containing Compounds



A'12-A'21-	Y'65-	Y'66-	R'16-	r'
6-[2',4'-Cl <sub>2</sub> C <sub>6</sub> H <sub>3</sub> O-]	2-Cl	4-Cl	3,5-H <sub>2</sub>	0
5-[4'-ClC <sub>6</sub> H <sub>4</sub> -O-]	2-Cl	4-Cl	3-H-6-Cl	0
4-C <sub>6</sub> H <sub>5</sub> O-	2-Cl	6-Cl	3,5-H <sub>2</sub>	0
6-[4'-C <sub>6</sub> H <sub>5</sub> O-C <sub>6</sub> H <sub>4</sub> O-]	2-F	4-F	3,5-H <sub>2</sub>	0
6-[2',4'-(O <sub>2</sub> N) <sub>2</sub> C <sub>6</sub> H <sub>3</sub> NH-]	2-F	4-F	3-H-5-CH <sub>3</sub>	0
4-[4'-ClC <sub>6</sub> H <sub>4</sub> S-]	2-F	6-F	3,5-H <sub>2</sub>	0
5-C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> -	2-Cl	4-Cl	3,6-H <sub>2</sub>	0
4-(1-naphthoxy)	2-F	6-Cl	3,5-H <sub>2</sub>	0
4-[2',6'-Cl <sub>2</sub> -4'-pyridiny]-S-]	2-Cl	6-Cl	3,5-H <sub>2</sub>	0
6-[4'-C <sub>6</sub> H <sub>5</sub> O-C <sub>6</sub> H <sub>4</sub> CH <sub>2</sub> -]	2-F	3-F	4,5-H <sub>2</sub>	0
5-[2',4'-Cl <sub>2</sub> C <sub>6</sub> H <sub>3</sub> O-]	2-Cl	3-Cl	4-H	1
4-[4'-C <sub>6</sub> H <sub>5</sub> O-C <sub>6</sub> H <sub>4</sub> O-]	2-F	6-F	3,5-H <sub>2</sub>	1
6-[3',4',5'-Br <sub>3</sub> C <sub>6</sub> H <sub>2</sub> NH-]	2-F	5-F	3,4-H <sub>2</sub>	1
6-C <sub>6</sub> H <sub>5</sub> O-	2-Cl	-	3-NO <sub>2</sub> -4,5-H <sub>2</sub>	0
4-[3',5'-Cl <sub>2</sub> C <sub>6</sub> H <sub>3</sub> S]	2-F	3-CN	5,6-H <sub>2</sub>	0
4-[2',4'-Cl <sub>2</sub> C <sub>6</sub> H <sub>3</sub> O-]	2-Cl	-	6-CCl <sub>3</sub> -3,5-H <sub>2</sub>	0
5-[3'-C <sub>6</sub> H <sub>5</sub> O-C <sub>6</sub> H <sub>4</sub> O-]	2-Cl	6-Cl	3-CCl <sub>3</sub> -4-H	0

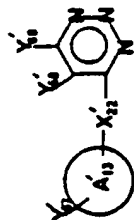
TABLE 29 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



A'-12-A'-21-	Y'-65-	Y'-66-	R'-16-	r'-
5-C <sub>6</sub> H <sub>5</sub> SO <sub>2</sub>	2-Cl	4-Cl	6-Cl	0
5-(2,4-Cl <sub>2</sub> C <sub>6</sub> H <sub>3</sub> )SO <sub>2</sub> -	2-Cl	4-Cl	6-Cl	0
4-C <sub>6</sub> H <sub>5</sub> S	2-Cl	3-Cl	5-Cl	1
4-CF <sub>3</sub> -2-NO <sub>2</sub> C <sub>6</sub> H <sub>3</sub>	2-Cl	4-Cl	H	0
5-(4-ClC <sub>6</sub> H <sub>4</sub> )SO <sub>2</sub> -	2-Cl	4-Cl	6-Cl	0

TABLE 30

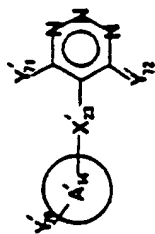
Representative Heterocyclic Nitrogen - Containing Compounds



$Y'_{67}-$	$A'_{13}-$	$X'_{22}-$	$Y'_{68}-$	$Y'_{69}-$
H	phenyl	O	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	O	Cl	Cl
3,5-Cl <sub>2</sub>	phenyl	O	Cl	Cl
4-Br	phenyl	O	Cl	Cl
3-NO <sub>2</sub>	phenyl	S	Cl	Cl
2-CN	phenyl	O	Cl	Cl
4-(4'-ClC <sub>6</sub> H <sub>4</sub> O)	phenyl	O	Cl	Cl
4-Cl	phenyl	NH	F	F
5-C <sub>2</sub> H <sub>5</sub>	2-pyridyl	NH	Cl	Cl
5-Cl		O	Cl	Cl
5-Br		S	Br	Br
H	1-naphthyl	O	Cl	Cl
4-Cl	phenyl	CH <sub>2</sub>	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	single bond	Cl	Cl
H	phenyl	-C≡C-	Cl	Cl




TABLE 31

Representative Heterocyclic Nitrogen - Containing Compounds



Y <sub>70</sub> -	A <sub>14</sub> -	X <sub>23</sub> -	Y <sub>71</sub> -	Y <sub>72</sub> -
H	phenyl	O	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	O	Cl	Cl
3,5-Cl <sub>2</sub>	phenyl	O	Cl	Cl
4-Br	phenyl	O	Cl	Cl
3-NO <sub>2</sub>	phenyl	S	Cl	Cl
2-CN	phenyl	O	Cl	Cl
4-(4'-ClC <sub>6</sub> H <sub>4</sub> O)	phenyl	O	Cl	Cl
4-Cl	phenyl	NH	F	F
5-C <sub>2</sub> H <sub>5</sub>	2-pyridyl	NH	Cl	Cl
5-Cl		O	Cl	Cl
5-Br		S	Br	Br
H	1-naphthyl	O	Cl	Cl
4-Cl	phenyl	CH <sub>2</sub>	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	single bond	Cl	Cl
H	phenyl	-C≡C-	Cl	Cl

TABLE 32  
Representative Heterocyclic Nitrogen - Containing Compounds

$Y'_{73}-$	$A'_{15}-$	$X'_{24}-$	$Y'_{74}-$	$Y'_{75}-$
2,4-Cl <sub>2</sub>	phenyl	O	Cl	Cl
3,5-Cl <sub>2</sub>	phenyl	O	Cl	Cl
4-NO <sub>2</sub>	phenyl	O	Cl	Cl
4-CN	phenyl	O	Cl	Cl
3,5-Cl <sub>2</sub>	phenyl	S	Cl	Cl
4-Cl	1-naphthyl	O	Cl	Cl
3-C <sub>6</sub> H <sub>5</sub> O	phenyl	NH	Cl	Cl
5-Cl		S	Br	Br
5-C <sub>2</sub> H <sub>5</sub>		NH	Cl	Cl
H	phenyl	O	Cl	Cl
5-Cl		O	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	NH	Cl	Cl
4-(4'-ClC <sub>6</sub> H <sub>4</sub> O)	phenyl	O	Cl	Cl
4-Cl	phenyl	CH <sub>2</sub>	Cl	Cl

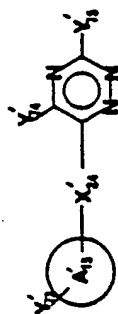
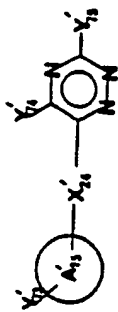




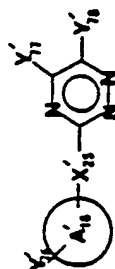
TABLE 32 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Y'73-	A'15-	A'24-	Y'74-	Y'75-
2,4-Cl <sub>2</sub>	phenyl	single bond	Cl	Cl
H	phenyl	-C≡C-	Cl	Cl

TABLE 33

Representative Heterocyclic Nitrogen - Containing Compounds






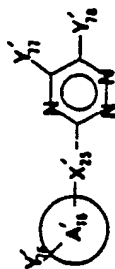
Y'76-	A'16-	A'25-	Y'77-	Y'78-
H	phenyl	O	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	O	Cl	Cl
3,5-Cl <sub>2</sub>	phenyl	O	Cl	Cl
4-NO <sub>2</sub>	phenyl	O	Cl	Cl
4-CN	phenyl	O	Cl	Cl
3,5-Cl <sub>2</sub>	phenyl	S	Cl	Cl
4-Cl	1-naphthyl	O	Cl	Cl
3-C <sub>6</sub> H <sub>5</sub> O-	phenyl	NH	Cl	Cl
5-Cl		S	Br	Br
5-C <sub>2</sub> H <sub>5</sub>		NH	Cl	Cl
5-Cl		O	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	NH	Cl	Cl

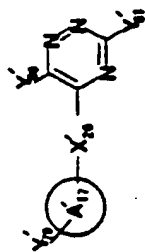
TABLE 33 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



<u>Y'76-</u>	<u>A'16-</u>	<u>X'25-</u>	<u>Y'77-</u>	<u>Y'78-</u>
4-(4'-ClC <sub>6</sub> H <sub>4</sub> O)	phenyl	O	Cl	Cl
4-Cl	phenyl	CH <sub>2</sub>	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	single bond	Cl	Cl
H	phenyl	-C≡C-	Cl	Cl

TABLE 34  
Representative Heterocyclic Nitrogen - Containing Compounds



Y <sub>17</sub> -	A <sub>17</sub> -	X <sub>18</sub> -	Y <sub>18</sub> -	Y <sub>19</sub> -
3,5-Cl <sub>2</sub>	phenyl	O	Cl	Cl
4-NO <sub>2</sub>	phenyl	O	Cl	Cl
4-CN	phenyl	O	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	NH	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	O	Cl	Cl
3-C <sub>6</sub> H <sub>5</sub> O	phenyl	NH	Cl	Cl
2,6-Cl <sub>2</sub>	phenyl	-CH=NO-	Cl	Cl
3,5-Cl <sub>2</sub>	phenyl	S	Cl	Cl
2-NO <sub>2</sub>	phenyl	NH	Cl	Cl
2,3-(CH <sub>2</sub> ) <sub>4</sub>	phenyl	O	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	O	F	F
3,5-Cl <sub>2</sub>	phenyl	O	Br	Br
2,5-Cl <sub>2</sub>	phenyl	O	F	F
3,5-Cl <sub>2</sub>	phenyl	S	Br	Br
2-Cl-2,3-(CH <sub>2</sub> ) <sub>4</sub> -	phenyl	O	Cl	Cl
4-(4'-C <sub>6</sub> H <sub>5</sub> O-C <sub>6</sub> H <sub>4</sub> )-	phenyl	O	Cl	Cl

The diagram shows a benzene ring with several substituents. One carbon atom on the ring is bonded to a substituent labeled 'X', a hydrogen atom (H), and a group labeled 'A'.



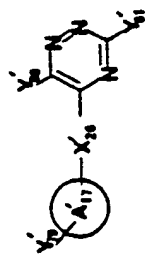
$\overline{Y'_{17}}-$	$\overline{A'_{17}}-$	$\overline{X'_{26}}-$	$\overline{Y'_{80}}-$	$\overline{Y'_{81}}-$
2-NO <sub>2</sub>	phenyl	$-N \begin{smallmatrix} \diagup \\ \diagdown \end{smallmatrix} \begin{smallmatrix} COC_3H_3 \\ COC_3H_3 \end{smallmatrix}$	Cl	Cl
4-CH <sub>3</sub> S		S	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	S	Cl	Cl
H	1-naphthyl	O	Cl	Cl
2,4-Cl <sub>2</sub>	phenyl	O	CN	CN
H	1-naphthyl	O	OSO <sub>2</sub> CH <sub>3</sub>	OSO <sub>2</sub> CH <sub>3</sub>
3-C <sub>6</sub> H <sub>5</sub> O-	phenyl	S	CCl <sub>3</sub>	CCl <sub>3</sub>
4-CH <sub>3</sub> O-	phenyl	O	CN	OSO <sub>2</sub> CF <sub>3</sub>
5-C <sub>6</sub> H <sub>5</sub> O-	3-pyridinyl	S	CN	OCOC <sub>2</sub> H <sub>5</sub>
2,4-Cl <sub>2</sub>	phenyl	O	OCH <sub>2</sub> CF <sub>3</sub>	OCH <sub>2</sub> CF <sub>3</sub>
2,6-(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub>		O	$-N^{\oplus}(CH_3)_3$	CN
3,4,5-Br <sub>3</sub>	phenyl	S	CF <sub>3</sub>	CCl <sub>3</sub>

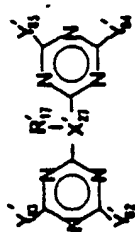
TABLE 34 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Y <sub>179</sub> -	A <sub>17</sub> -	X <sub>26</sub> -	Y <sub>80</sub> -	Y <sub>81</sub> -
		0	NO <sub>2</sub>	$\begin{matrix} \text{O} \\   \\ \text{OCC}_2\text{H}_5 \end{matrix}$
2,4-Cl <sub>2</sub>	phenyl	0	Cl	OCH <sub>3</sub>
4-Cl	phenyl	0	Cl	CN
3,5-Br <sub>2</sub>	phenyl	0	Cl	OCH <sub>2</sub> CF <sub>3</sub>
3-NO <sub>2</sub>	phenyl	0	Cl	SC <sub>2</sub> H <sub>5</sub>
2,4,5-Cl <sub>3</sub>	phenyl	0	Cl	SO <sub>2</sub> CH <sub>3</sub>
4-CF <sub>3</sub>	phenyl	0	OCH <sub>2</sub> CF <sub>3</sub>	OCH <sub>2</sub> CF <sub>3</sub>
3-CN	phenyl	0	OCH <sub>2</sub> CF <sub>3</sub>	Cl
3-C <sub>6</sub> H <sub>5</sub> O	phenyl	0	CH <sub>3</sub> S-	Cl
3,4,5-(CH <sub>3</sub> ) <sub>3</sub> -	phenyl	0	CCl <sub>3</sub>	Cl
3,5-Cl <sub>2</sub>	phenyl	0	CH <sub>3</sub> O-	Cl
3,5-Cl <sub>2</sub>	phenyl	0	Cl	CH <sub>3</sub> O-
2,4-Cl <sub>2</sub>	phenyl	S	F	(CH <sub>3</sub> ) <sub>2</sub> N-
4-C <sub>6</sub> H <sub>5</sub> O-	phenyl	0	NO <sub>2</sub>	Cl
4-CH <sub>3</sub> S-	phenyl	0	Cl	Cl
2,4-F <sub>2</sub>	phenyl	0	Cl	Cl

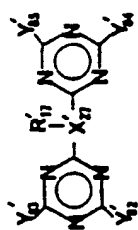
TABLE 35

Representative Heterocyclic Nitrogen - Containing Compounds



Y'82-	Y'83-	X'27-	R'17-	Y'84-	Y'85-
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl			--	Cl	Cl
Cl			--	Cl	Cl
Cl			--	Cl	Cl
Cl			--	Cl	Cl

### Representative Heterocyclic Nitrogen - Containing Compounds



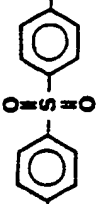

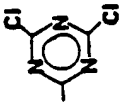


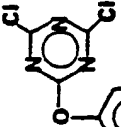

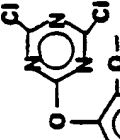

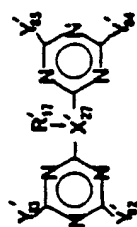
Y'82-	Y'83-	X'27-	R'17-	Y'84-	Y'85-
Cl	Cl			Cl	Cl
Cl	Cl	N	H	Cl	Cl
Cl	Cl	N		Cl	Cl
Cl	Cl	N		Cl	Cl
Cl	Cl	N		Cl	Cl
Cl	Cl			Cl	Cl
Cl	Cl			Cl	Cl



TABLE 35 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds

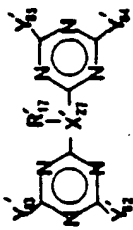


Y'82-	Y'83-	X'27-	R'17-	Y'84-	Y'85-
Cl	Cl	-NH-NH-	--	Cl	Cl
Cl	Cl	-N=N-	--	Cl	Cl
Cl	Cl	-S-	--	Cl	Cl
Cl	Cl	-S-	--	Cl	Cl
		0			
Cl	Cl	-SO2	--	Cl	Cl
Cl	Cl	single bond	--	Cl	Cl
Cl	Cl	-S-S-	--	Cl	Cl
			.		
Cl	Cl	-O-	--	Cl	Cl
Cl	Cl	-C-	--	Cl	Cl
		0			
Cl	Cl	-C=C-	--	Cl	Cl
Cl	Cl	-C-NH-	--	Cl	Cl
		0			
Cl	Cl		--	Cl	Cl



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### Representative Heterocyclic Nitrogen - Containing Compounds




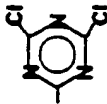
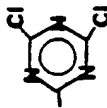
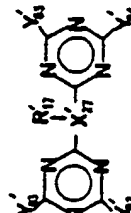
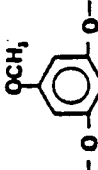
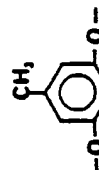
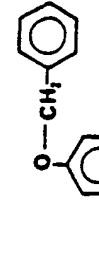
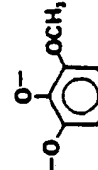
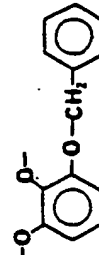
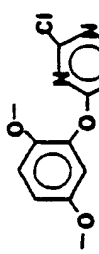
<u>Y'82-</u>	<u>Y'83-</u>	<u>X'27-</u>	<u>B'17-</u>	<u>Y'84-</u>	<u>Y'85-</u>
C1	C1	N	n-C <sub>4</sub> H <sub>9</sub> -	C1	C1
C1	C1	N		C1	C1
C1	C1	N	CH <sub>2</sub> =CHCH <sub>2</sub> -	C1	C1
C1	C1	N	CH <sub>3</sub> O-CO-	C1	C1
C1	C1	N	CH <sub>3</sub> SO <sub>2</sub> -	C1	C1
C1	C1	N	Cf <sub>3</sub> SO <sub>2</sub> -	C1	C1
C1	C1	P	Cl	C1	C1
C1	C1	P		C1	C1
C1	C1	P	OC <sub>2</sub> H <sub>5</sub>	C1	C1
C1	C1	P=O	Cl	C1	C1
C1	C1	P=O		C1	C1

TABLE 35 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

		X'27-		Y'82-	Y'83-
Cl	Cl	P=O	CH <sub>3</sub> O-	Cl	Cl
Cl	Cl		CH <sub>3</sub>	Cl	Cl
Cl	Cl		CH <sub>3</sub>	Cl	Cl
Cl	Cl		CH <sub>3</sub>	Cl	Cl
Cl	Cl		CH <sub>3</sub>	Cl	Cl
Cl	Cl		CH <sub>3</sub>	Cl	Cl
Cl	Cl		CH <sub>3</sub>	Cl	Cl



**TABLE 35 (Cont.)**  
**Representative Heterocyclic Nitrogen - Containing Compounds**

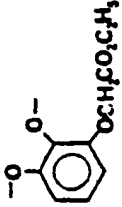
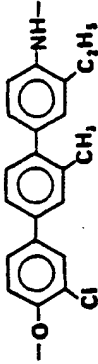
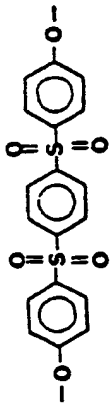


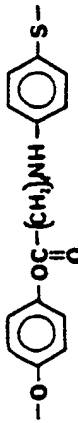
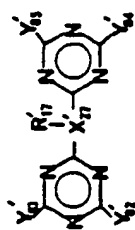
$\underline{Y'_{82}-}$	$\underline{Y'_{83}-}$	$\underline{X'_{27}-}$	$\underline{R'_{17}-}$	$\underline{Y'_{84}-}$	$\underline{Y'_{85}-}$
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	F	Cl

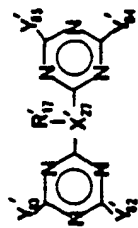
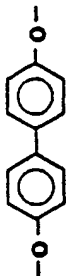

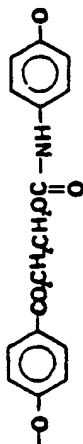
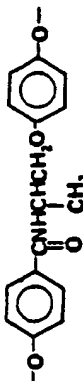
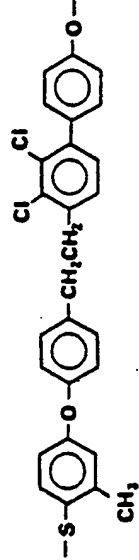
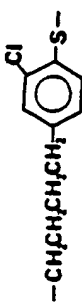
TABLE 35 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



Y'-82-	Y'-83-	X'-27-	R'-17-	Y'-84-	Y'-85-
Cl	Cl		--	F	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl

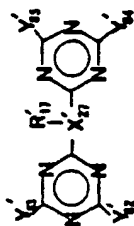
TABLE 35 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

				
Y'82-	Y'83-	X'27-	R'17-	Y'84- Y'85-
Cl	Cl		--	Cl Cl
Cl	Cl		--	Cl Cl
Cl	Cl		--	Cl Cl
CH <sub>3</sub> O	Cl		--	Cl Cl
Cl	Cl		--	Cl Cl
Cl	Cl		--	Cl Cl



**TABLE 35 (Cont.)**

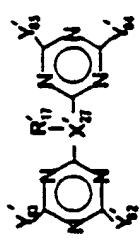
### Representative Heterocyclic Nitrogen - Containing Compounds



Y'82-	Y'83-	X'27-	R'17-	Y'84-	Y'85-
Cl	Cl	$\text{--OCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{O--}$	--	Cl	Cl
Cl	Cl	$\text{--SCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{O--}$	--	Cl	Cl
Cl	Cl	$\text{--OCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{O--}$	--	Cl	Cl
Cl	Cl	$\text{--NCO-NH-C}_6\text{H}_4\text{--C(=O)-NH-C}_6\text{H}_3\text{(Cl)-CO-C}_6\text{H}_4\text{--O--}$	--	Cl	Cl
Cl	Cl	$\text{--NHCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CO--}$	--	Cl	Cl
Cl	Cl	$\text{--O-C}_6\text{H}_4\text{--O-C(=O)-C}_6\text{H}_4\text{--C(=O)-O-C}_6\text{H}_4\text{--O--}$	--	Cl	Cl



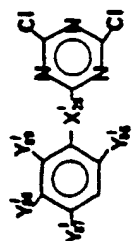
TABLE 35 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Y'82-	Y'83-	X'27-	Y'17-	Y'84-	Y'85-
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
Cl	Cl		--	Cl	Cl
CH3	Cl		--	Cl	Cl

TABLE 36

Representative Heterocyclic Nitrogen - Containing Compounds

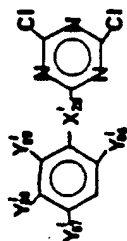


Y'86-	Y'87-	Y'88-	Y'89	X'20-
H		H	H	O
H		-CH=CH-CH=CH-		O
H	n-C7H15O-	H	H	O
H	H		H	O
H	n-C9H19-	H	H	O
H		H	H	O
H		H	H	O

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TABLE 36 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds

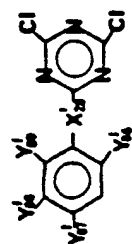


Y'86-	Y'87-	Y'88-	Y'89	X'28-
H		H	H	0
H		H	H	0
H		H	H	0
H		H	H	0
Cl		H	Cl	0
H		H	H	0

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TABLE 36 (Cont.)

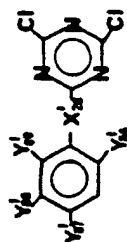
Representative Heterocyclic Nitrogen - Containing Compounds



Y'86-	Y'87-	Y'88-	Y'89	X'28-
Cl		H	Cl	0
H		H	H	0
Cl		H	Cl	0
Cl		H	Cl	0
H		H	H	0
H		H	H	0

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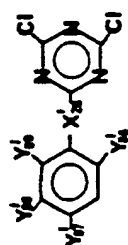
TABLE 36 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Y'86--	Y'87--	Y'88--	Y'89	X'28--
H		H	H	0
H		H	H	0
H		H	H	0
H		H	H	0
H		H	H	0
H		H	H	0

TABLE 36 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



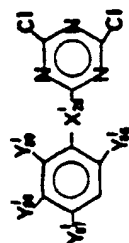
$Y'_{86}$ -	$Y'_{87}$ -	$Y'_{88}$ -	$Y'_{89}$	$X'_{28}$ -
H		H	H	O
H		H	H	O
H		H	H	O
H		H	H	O
H		H	H	O
CH <sub>3</sub>		H	H	S

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TABLE 36 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds

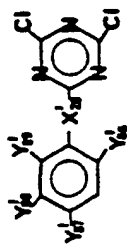


Y'86-	Y'87-	Y'88-	Y'89	X'28-
H		H	H	O
H		H	H	SO <sub>2</sub>
H		CH <sub>3</sub>	H	O
H		H	H	O
H		H	H	O
H		H	H	O
H		H	H	O

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TABLE 36 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds

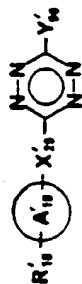


Y'86-	Y'87-	Y'88-	Y'89	X'28-
H		H	H	S
H		H	H	NH
H	CH <sub>3</sub> CH <sub>2</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>2</sub> -	Cl	Cl	O
Cl		Cl	H	NH
H		H	H	O
H		H	H	O

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TABLE 37

Representative Heterocyclic Nitrogen - Containing Compounds



R'10-	A'18-	A'29-	Y'90
H	phenyl	O	Cl
4-Cl	phenyl	O	Cl
2,4-Cl <sub>2</sub>	phenyl	O	Cl
3-CN	phenyl	O	Cl
2,4-(CH <sub>3</sub> ) <sub>2</sub>	phenyl	O	Cl
2-CH <sub>3</sub> -4-Cl	phenyl	O	Cl
4-C <sub>6</sub> H <sub>5</sub> O-	phenyl	O	Cl
3-C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> O-	phenyl	O	Cl
3,5-Cl <sub>2</sub>	phenyl	O	Cl
2,4,5-Br <sub>3</sub>	phenyl	S	Cl
2,4-Cl <sub>2</sub>	phenyl	S	Cl
3-(4-Cl-C <sub>6</sub> H <sub>4</sub> )-	phenyl	S	Cl
4-Cl	phenyl	NH	Cl
4-Cl	phenyl	NH	F
3,4,5-(CH <sub>3</sub> ) <sub>3</sub>	phenyl	NH	F
3-C <sub>6</sub> H <sub>5</sub> O-	phenyl	NH	F
3-NO <sub>2</sub>	phenyl	O	F
3,4-Cl <sub>2</sub>	phenyl	CH <sub>2</sub>	Cl

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TABLE 37 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds

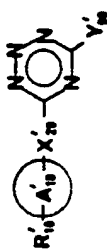


R'10-	A'10-	X'29-	Y'90
2,4-Cl <sub>2</sub>	phenyl	single bond	Cl
H	phenyl	single bond	Cl
4-(C <sub>6</sub> H <sub>5</sub> O)-	phenyl	single bond	F
4-CF <sub>3</sub>	phenyl	-CONH-	Cl
3-Cl	phenyl	-C≡C-	Cl
H	1-naphthyl	O	Cl
4-Cl	1-naphthyl	O	Cl
5,6,7,8-H <sub>4</sub>	1-naphthyl	O	F
6-CH <sub>3</sub>	3-pyridinyl	O	F
3-Cl	4-pyridinyl	O	Cl
5-Cl	2-thienyl	O	Cl
3-Cl	phenyl	O	Br
H	2-benzoxazolyl	NH	Br
H	2-naphthyl	O	Cl
2,4-Cl <sub>2</sub>	phenyl	-CH <sub>2</sub> O-	Cl

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TABLE 3B

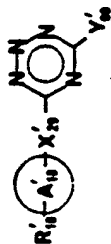
Representative Heterocyclic Nitrogen - Containing Compounds



$R'_{10}$	$A'_{11}$	$X'_{12}$	$Y'_{12}$
H	phenyl	O	Cl
H	phenyl	S	Cl
4-Cl	phenyl	O	Cl
3,5-Cl <sub>2</sub>	phenyl	S	Cl
4-C <sub>6</sub> H <sub>5</sub> O-	phenyl	O	Cl
2,4-Br <sub>2</sub>	phenyl	S	Cl
4-CH <sub>3</sub>	phenyl	O	F
3-(4-Cl-C <sub>6</sub> H <sub>4</sub> O)	phenyl	O	Cl
3-C <sub>6</sub> H <sub>5</sub> O-	phenyl	NH	Cl
3-C <sub>6</sub> H <sub>5</sub> O-	phenyl	NH	F
2,4-Cl <sub>2</sub>	phenyl	CH <sub>2</sub>	Cl
2,4,5-Cl <sub>3</sub>	phenyl	single bond	Cl
4-CH <sub>3</sub> O-	phenyl	single bond	Cl
3,5-(CH <sub>3</sub> O) <sub>2</sub>	phenyl	O	Cl
2-Br-4-Cl	phenyl	O	Br
3-Cl-4-CH <sub>3</sub> CH <sub>2</sub> O	phenyl	-CH <sub>2</sub> CH <sub>2</sub> -	Cl
3-CH <sub>3</sub> CH <sub>2</sub> O-4-CH <sub>3</sub>	phenyl	-CONH-	Cl
H	1-naphthyl	O	Cl

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TABLE 38 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R'10-	A'10-	X'29-	Y'90
H	2-naphthyl	O	Cl
5-CH <sub>3</sub> CH <sub>2</sub>	3-pyridinyl	-NH-	F
4-Br	2-thienyl	O	Cl
4-CH <sub>3</sub>	2-thiazolyl	-NH-	F
H	phenyl	-C≡C-	Cl
2,4-Cl <sub>2</sub>	phenyl	-CH <sub>2</sub> O-	Cl
H	phenyl	-CH <sub>2</sub> O-	Cl
5,6,7,8-H <sub>4</sub>	1-naphthyl	O	Cl
3,4,5-Cl <sub>3</sub>	phenyl	CH <sub>2</sub>	Br

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TABLE 39

Representative Heterocyclic Nitrogen - Containing Compounds



R'18-	A'18-	X'29-	Y'90
H	phenyl	O	Cl
2,4-Cl <sub>2</sub>	phenyl	O	Cl
2,6-Cl <sub>2</sub>	phenyl	O	Cl
3-C <sub>6</sub> H <sub>5</sub> O-	phenyl	O	Cl
4-C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> -	phenyl	O	Cl
3,4-(CH <sub>3</sub> ) <sub>2</sub>	phenyl	S	Cl
3,5-Cl <sub>2</sub>	phenyl	S	Cl
4-(4-ClC <sub>6</sub> H <sub>4</sub> O)-	phenyl	S	Cl
2,4-(CH <sub>3</sub> O) <sub>2</sub>	phenyl	O	Cl
3,4-OCH <sub>2</sub> O-	phenyl	O	Cl
2,3-OCH <sub>2</sub> O-	phenyl	NH	F
4-Cl	phenyl	NH	F
3-NO <sub>2</sub>	phenyl	O	F
2-NO <sub>2</sub>	phenyl	O	Cl
3-CH <sub>3</sub> CH <sub>2</sub> -	phenyl	O	Cl
H	phenyl	CH <sub>2</sub>	Cl
H	phenyl	single bond	Cl
3,5-Br <sub>2</sub>	phenyl	single bond	Cl

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TABLE 39 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



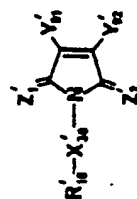
R'10-	A'10-	X'29-	Y'90
2-CH <sub>3</sub> -4-Cl	phenyl	CH <sub>2</sub> O	Cl
3-Cl	phenyl	CH <sub>2</sub>	Br
4-Cl	phenyl	CH <sub>2</sub> O	Br
H	1-naphthyl	O	Cl
H	2-naphthyl	O	Cl
4-Cl	1-naphthyl	O	Cl
4-CH <sub>3</sub>	2-pyridinyl	O	Cl
H	3-pyridinyl	O	F
5-Cl	2-thienyl	O	Cl
5-CH <sub>3</sub>	3-isoxazolyl	NH	F
H	phenyl	-C≡C-	Cl
2,5-Cl <sub>2</sub>	phenyl	O	Br

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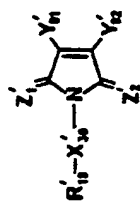
TABLE 40

Representative Heterocyclic Nitrogen - Containing Compounds



$R'_{19}$	$X'_{30}$	$Z'_1$	$Z'_2$	$Y'_{91}$	$Y'_{92}$
$(CH_3)_2CHCH_2CH_2-$	single bond	0	0	Cl	Cl
$CH_2=CHCH_2-$	single bond	0	0	Cl	Cl
$HC\equiv CCH_2-$	single bond	0	0	Cl	Cl
$HC-$ 0	single bond	0	0	Cl	Cl
$HN-C-$ NH <sub>2</sub>	single bond	0	0	Cl	Cl
HO-	single bond	0	0	Cl	Cl

TABLE 40 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

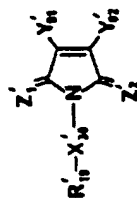


R'19	X'30	Z'1	Z'2	Y'91	Y'92
CH <sub>3</sub> (CH <sub>2</sub> ) <sub>16</sub> - O	single bond	0	0	Cl	Cl
H <sub>2</sub> N-C- S	single bond	0	0	Cl	Cl
(HOCH <sub>2</sub> ) <sub>3</sub> C-	single bond	0	0	Cl	Cl
H <sub>2</sub> N-C- O	single bond	0	0	Cl	Cl
CH <sub>3</sub> OCH <sub>2</sub> CH <sub>2</sub> -	single bond	0	0	Cl	Cl
5-bromo-2-thiazolyl	single bond	0	0	Cl	Cl

φ<sup>4</sup> φ<sup>4</sup>

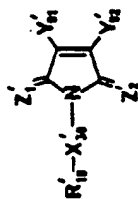
φ<sup>4</sup> φ<sup>4</sup>

TABLE 4D (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R'19	X'30	Z'1	Z'2	Y'91	Y'92
2-pyridinyl	single bond	0	0	Cl	Cl
5-bromo-2-pyridinyl	single bond	0	0	Cl	Cl
6-methyl-4-pyrimidinyl	single bond	0	0	Cl	Cl
2-benzimidazolyl	single bond	0	0	Cl	Cl
2-(2-indolyl)ethyl	single bond	0	0	Cl	Cl
2-thienylcarboxamido	single bond	0	0	Cl	Cl

TABLE 40 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds

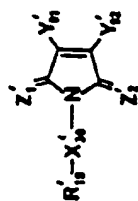


R'19	X'30	Z'1	Z'2	Y'91	Y'92
2-benzoxazolyl	single bond	0	0	Cl	Cl
2-benzothiazolyl	single bond	0	0	Cl	Cl
3-pyridinylmethyl	single bond	0	0	Cl	Cl
2-pyridinylmethyl	single bond	0	0	Cl	Cl
4-pyridinylmethyl	single bond	0	0	Cl	Cl
3-phenyl-2-propenyl	single bond	0	0	Cl	Cl

4  
5

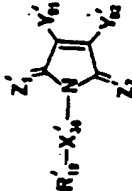
4  
5

TABLE 40 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R'19	X'30	Z'1	Z'2	Y'91	Y'92
phenylethynyl	single bond	0	0	Cl	Cl
4-tolylsulfonyl	single bond	0	0	Cl	Cl
3-phenylpropyl	single bond	0	0	Cl	Cl
	single bond	0	0	Cl	Cl
	single bond	0	0	Cl	Cl
phenyl	single bond	0	0	F	F

TABLE 40 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



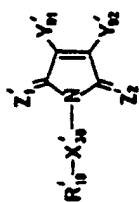
<u>R'19</u>	<u>X'30</u>	<u>Z'1</u>	<u>Z'2</u>	<u>Y'91</u>	<u>Y'92</u>
2-phenylethyl	single bond	0	0	Br	H
benzenesulfonyl	single bond	0	0	CH3	Cl
benzyl	single bond	0	0	Cl	Br
C2H5	single bond	0	0	F	Cl
cyclohexyl	single bond	0	0	F	Cl
cyclohexyl	single bond	0	0	F	H

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b\* 4\*

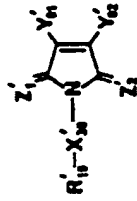
TABLE 40 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



R'19	X'30	Z'1	Z'2	Y'91	Y'92
n-C <sub>3</sub> H <sub>7</sub>	single bond	0	0	Br	H
	-CH <sub>2</sub> CH <sub>2</sub> -	0	0	Cl	Cl
	-CH <sub>2</sub> CH <sub>2</sub> -	0	0	Br	H
	-CH <sub>2</sub> CH <sub>2</sub> -	0	0	Br	Br
4-methyl-2-thiazolyl	-NH-	0	0	Cl	Cl
4-chloro-2-benzothiazolyl	-NH-	0	0	Cl	Cl

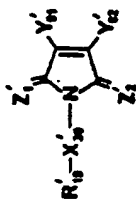
TABLE 40 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R'19	X'30	Z'1	Z'2	Y'91	Y'92
3-methyl-5-isoxazolyl	-NH-	0	0	Cl	Cl
5-methyl-3-isoxazolyl	-NH-	0	0	Cl	Cl
3-methyl-5-isothiazolyl	-NH-	0	0	Cl	Cl
5-bromo-3-isothiazolyl	-NH-	0	0	Cl	Cl
5-ethyl-2-(1,3,4-thiadiazolyl)	-NH-	0	0	Cl	Cl
3,5-dimethyl-2-pyrimidinyl	-NH-	0	0	Cl	Cl

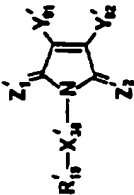


TABLE 40 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



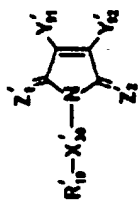
R'19	X'30	Z'1	Z'2	Y'91	Y'92
	-CH2	0	0	Cl	Cl
	-CH2-	0	0	Br	H
	-(CH2)3-	0	0	Cl	Cl
	-(CH2)4-	0	0	Cl	Cl
2-thienyl	-CH2-	0	0	Cl	Cl
2-methoxyphenyl	-NH-	S	S	Cl	H

TABLE 40 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R'19	X'30	Z'1	Z'2	Y'91	Y'92
3,4-dichlorophenyl	-NH-	S	S	Cl	Cl
phenyl	-CH2-	S	S	Cl	Cl
4-chlorophenyl	-CH2-	S	S	Cl	CH3
3-methyl-4-chlorophenyl	single bond	S	S	Br	H
phenyl	-CH2-	O	O	Br	Cl
2-furyl	-CH2-	CH3N	O	Cl	Cl

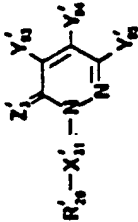
TABLE 40 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



$R'_{19}$	$X'_{30}$	$Z'_1$	$Z'_2$	$Y'_{91}$	$Y'_{92}$
1-methyl-3-indolyl	$-\text{CH}(\text{CH}_3)-$	$\text{C}_2\text{H}_5\text{N}$	0	Cl	Cl
3-chlorophenyl	$-\text{N}(\text{CH}_3)-$	0	0	Cl	H
	$-\text{CH}_2-$	0	0	Cl	Cl
	single bond	0	0	Cl	H
	single bond	0	0	Cl	H

TABLE 41

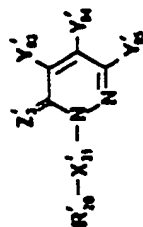
Representative Heterocyclic Nitrogen - Containing Compounds



R'20	X'31	Z'3	Y'93	Y'94	Y'95
2,4-dichlorophenyl	single bond	S	Cl	Cl	Cl
2,4-dichlorophenyl	single bond	CH2	Cl	Cl	Cl
phenyl	single bond	CH2	F	F	F
2,4-dichlorophenyl	single bond	NH	H	H	Br
phenyl	single bond	NCH3	F	F	F
4-chlorophenyl	single bond	NH	Cl	Cl	Cl

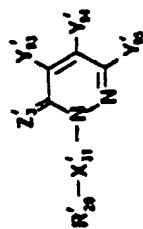
TABLE 41 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



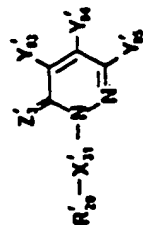
$R'_{20}$	$X'_{31}$	$Z'_3$	$Y'_{93}$	$Y'_{94}$	$Y'_{95}$
2,4-dichlorophenyl	single bond	NH	Cl	Cl	Cl
phenyl	$-CH_2CH_2-$	O	Cl	Cl	Cl
phenyl	$-CH_2-$	S	Cl	Cl	Cl
phenyl	$-CH(CH_3)-$	O	Cl	Cl	Cl
phenyl	$-CH_2-$	O	Cl	Cl	Cl
phenyl	$-CH=CH-$	O	Cl	Cl	Cl

TABLE 41 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



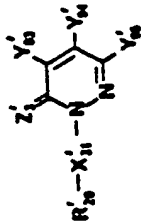
$R'_{20}$	$X'_{31}$	$Z'_{13}$	$Y'_{93}$	$Y'_{94}$	$Y'_{95}$
phenyl	-C≡C-	O	Cl	Cl	Cl
phenyl	-S(=O)-	O	Cl	Cl	Cl
phenyl	-SO <sub>2</sub> -	O	Cl	Cl	Cl
2-chlorophenyl	-CH <sub>2</sub> -	NH	Cl	Cl	Cl
1-naphthyl	single bond	O	Cl	Cl	Cl
1-naphthylmethyl	single bond	O	Cl	Cl	Cl

TABLE 41 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R'20	X'31	Z'3	Y'93	Y'94	Y'95
phenyl	single bond	0	H	Cl	Cl
cyclohexyl	single bond	0	Cl	Cl	Cl
n-butyl	single bond	0	Cl	Cl	Cl
	single bond	0	Cl	Cl	Cl
	single bond	0	Cl	Cl	Cl
4-phenoxyphenyl	single bond	0	Cl	Cl	Cl

TABLE 41 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



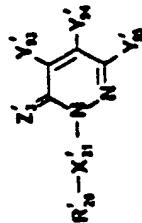
R'20	R'31	Z'3	Y'93	Y'94	Y'95
3-phenoxyphenyl	single bond	O	Cl	Cl	Cl
cyclohexyl	single bond	O	H	H	Br
cyclohexyl	single bond	O	F	F	F
phenyl	-CH2-	O	H	H	Br
H	single bond	O	Br	Br	OSO <sub>2</sub> CH <sub>3</sub>
H	single bond	O	H	H	OSO <sub>2</sub> CH <sub>3</sub>



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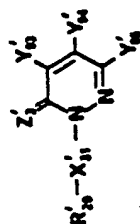
TABLE 41 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



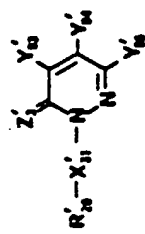
$R'_{20}$	$X'_{31}$	$Z'_{31}$	$Y'_{93}$	$Y'_{94}$	$Y'_{95}$
H	single bond	O	CH <sub>3</sub>	H	OSO <sub>2</sub> CH <sub>3</sub>
phenyl	single bond	O	Br	Br	OSO <sub>2</sub> CH <sub>3</sub>
phenyl	single bond	O	H	OCH <sub>3</sub>	OSO <sub>2</sub> CH <sub>3</sub>
phenyl	single bond	O	H	OCOCH <sub>3</sub>	OSO <sub>2</sub> CH <sub>3</sub>
cyclohexyl	single bond	O	Cl	Cl	OSO <sub>2</sub> CH <sub>3</sub>
phenyl	single bond	O	Cl	Cl	CN

TABLE 41 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R'20	X'31	Z'3	Y'93	Y'94	Y'95
H	single bond	O	Cl	Cl	OP(-S)(OC <sub>2</sub> H <sub>5</sub> ) <sub>2</sub>
phenyl	single bond	O	Cl	Cl	SCH <sub>3</sub>
2,4-dichlorophenyl	single bond	O	Cl	Cl	CF <sub>3</sub>
phenyl	single bond	O	Cl	Cl	OC <sub>2</sub> H <sub>5</sub>
(ClCH <sub>2</sub> CH <sub>2</sub> ) <sub>2</sub> NCH <sub>2</sub> -	single bond	O	Cl	Cl	Cl
phenyl	single bond	O	OCH <sub>3</sub>	Cl	Cl

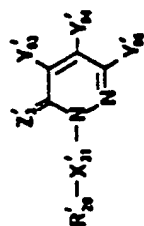
TABLE 41 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



$R'_{20}$	$R'_{31}$	$Z'_3$	$Y'_{93}$	$Y'_{94}$	$Y'_{95}$
phenyl	single bond	0		Cl	Cl
4-methylphenyl	single bond	0		H	Cl
phenyl	single bond	0		H	Cl
4-morpholinylmethyl	single bond	0	Cl	Cl	Cl
4-aminophenyl	single bond	0	Cl	Cl	Cl
4-nitrophenyl	single bond	0	Cl	Cl	Cl

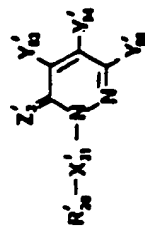
TABLE 4) (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



$R'_{20}$	$R'_{31}$	$Z'_3$	$Y'_{93}$	$Y'_{94}$	$Y'_{95}$
phenyl	single bond	O	Cl	Cl	Br
phenyl	single bond	O	$SCH_2CONHHCSNH_2$	H	Cl
$CH_3$	single bond	O	F	F	F
	single bond	O	Cl	Cl	Cl
	$CH_2$	O	Cl	Cl	Cl
	$CH_2$	S	Cl	Br	Cl

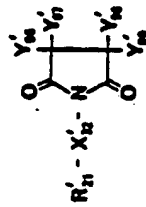
TABLE 41 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



R'20	X'31	Z'3	Y'93	Y'94	Y'95
3-chloro-2-pyridinyl	CH <sub>2</sub>	0	Cl	Cl	Cl
2-benzothiazolyl	single bond	0	Cl	Cl	Cl
5-chloro-2-thienyl	CH(CH <sub>3</sub> )-	0	Cl	Cl	Cl
5-methyl-3-isoxazolyl	single bond	0	Cl	Cl	Cl
3,5-dimethyl-2-pyrimidinyl	single bond	0	Cl	Cl	Cl
2-furyl	CH <sub>2</sub>	0	Cl	Cl	Cl

TABLE 42

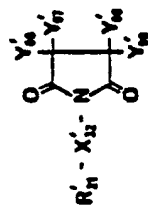
## Representative Heterocyclic Nitrogen - Containing Compounds



<u>R' 21</u>	<u>X' 32</u>	<u>Y' 96</u>	<u>Y' 97</u>	<u>Y' 98</u>	<u>Y' 99</u>
2-methoxyphenyl	-NH-	Cl	H	H	Cl
3-trifluoromethylphenyl	-CH <sub>2</sub> -	Cl	H	Cl	H
2,4-dichlorophenyl	-CH <sub>2</sub> -	Br	H	H	H
phenyl	-CH(CH <sub>3</sub> )-	Br	Br	H	H
3-aminophenyl	-CH <sub>2</sub> -	Br	Br	H	H
3-fluorophenyl	single bond	Br	Br	H	H
cyclohexyl	single bond	Cl	H	Cl	H

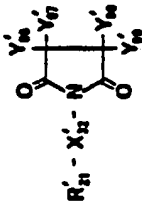
TABLE 42 (Cont.)

Representative Heterocyclic Nitrogen - Containing Compounds



<u>R' 21</u>	<u>X' 32</u>	<u>Y' 96</u>	<u>Y' 97</u>	<u>Y' 98</u>	<u>Y' 99</u>
phenyl	-CONH-	Br	H	Br	H
cyclohexyl	-CH <sub>2</sub> -	Br	H	Br	H
n-propyl	-CH <sub>2</sub> -	Br	H	Br	H
2-chlorophenyl	-NH-	H	H	Br	Br
phenyl	-CH <sub>2</sub> -	H	H	Cl	Cl
phenyl	-CH <sub>2</sub> -	H	Br	Br	H
2-methoxyphenyl	-CH <sub>2</sub> -	H	Br	Br	H

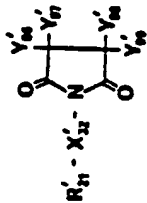
TABLE 42 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



<u>R' 21</u>	<u>X' 32</u>	<u>Y' 96</u>	<u>Y' 97</u>	<u>Y' 98</u>	<u>Y' 99</u>
phenyl	single bond	H	Cl	H	Cl
3-methoxyphenyl	-CH <sub>2</sub> -	Cl	Cl	H	H
3-fluorophenyl	-CH <sub>2</sub> -	Cl	Cl	H	H
3-bromophenyl	-CH <sub>2</sub> -	Cl	H	H	H
2-ethoxyphenyl	-NH-	Cl	Cl	H	H
n-propyl	-CH <sub>2</sub> -	Cl	H	Cl	H
2-furyl	-CH <sub>2</sub> -	Br	H	Br	H

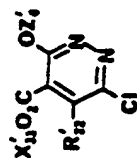


TABLE 42 (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



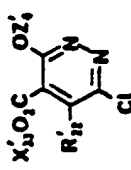
<u>R' 21</u>	<u>X' 32</u>	<u>Y' 96</u>	<u>Y' 97</u>	<u>Y' 98</u>	<u>Y' 99</u>
2-norbornyl	single bond	Cl	H	Br	H
3-pyridinyl	-N(CH3)-	F	H	H	Cl
5-isoxazolyl	-NH-	F	Br	H	H
2-naphthyl	-CH(CH3)-	Cl	Cl	Cl	H
3,5-dichlorophenyl	-CH2CH2-	Cl	Cl	Cl	Cl

TABLE 43  
Representative Heterocyclic Nitrogen - Containing Compounds



R' 22	X' 33	Z' 4
H	CH <sub>3</sub> CH <sub>2</sub>	H
CH <sub>3</sub>	CH <sub>3</sub> CH <sub>2</sub>	C <sub>2</sub> H <sub>5</sub>
n-C <sub>4</sub> H <sub>9</sub>	CH <sub>3</sub>	CH <sub>3</sub>
benzyl	CH <sub>3</sub> CH <sub>2</sub>	H
3-chlorobenzyl	CH <sub>3</sub>	COCH <sub>3</sub>
phenyl	H	H
4-chlorophenyl	n-C <sub>3</sub> H <sub>7</sub>	CH <sub>3</sub>
phenoxy	CH <sub>3</sub> CH <sub>2</sub>	H
phenoxy	CH <sub>3</sub> CH <sub>2</sub>	COC <sub>2</sub> H <sub>5</sub>
1-naphthyl	CH <sub>3</sub>	CH <sub>3</sub>

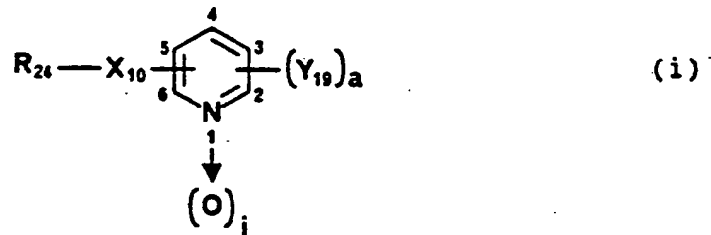
TABLE 43 (Cont.)  
 Representative Heterocyclic Nitrogen - Containing Compounds

	<u>R' 22</u>		<u>X' 33</u>		<u>Z' 4</u>	
	2,4-dichlorophenoxy		CH <sub>3</sub>		OCH <sub>3</sub>	
	3-pyridinylmethyl		CH <sub>3</sub> CH <sub>2</sub>		CO <sub>2</sub> C <sub>2</sub> H <sub>5</sub>	
	4-chlorothienyloxy		OH		H	

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It is appreciated that the particular compounds listed in Tables 1 through 43 hereinabove are illustrative of heterocyclic nitrogen-containing compounds which may be used in reducing transpirational water loss from plants and increasing crop yields according to this invention. This invention is not to be construed as being limited only to the use of these compounds; but rather, this invention includes those heterocyclic nitrogen-containing compounds encompassed within formula 1 hereinabove.

The novel heterocyclic nitrogen-containing compounds of this invention can be depicted by the following formulae:



wherein:

$R_{24}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{10}$  represents O, S, SO, SO<sub>2</sub>, NH, -CH<sub>2</sub>O-, -CH<sub>2</sub>S-, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)-, or -CONH-;

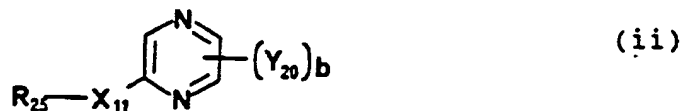
$j$  is a value of 0 or 1;

$a$  is a value of from 2 to 4 inclusive; and

$Y_{19}$  is the same or different and represents halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl,

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alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl;  
 provided that (i) at least two ring position pairs  
 selected from 2 and 4, 2 and 6, 2 and 3, and 3 and 4  
 are substituted with the same or different halogen;  
 (ii) when ring positions 2,4 and 6 are substituted  
 with chlorine and  $j$  is a value of 0 and  $X_{10}$  is  
 $SO_2$ , then  $R_{24}$  is not unsubstituted phenyl; and  
 (iii) when ring positions 2,3, and 5 are substituted  
 with chlorine and  $j$  is a value of 1 and  $X_{10}$  is S,  
 then  $R_{24}$  is not unsubstituted phenyl.



wherein:

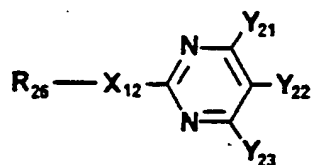
$R_{25}$  represents unsubstituted or  
 substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{11}$  represents O, S, SO,  $SO_2$ , NH,  
 $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  
 $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  
 $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  
 $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$ , or  $-CONH-$ ;

$b$  is a value of 2 to 3; and

$Y_{20}$  is the same or different and  
 represents halogen, alkyl, cyano, polyhaloalkyl,  
 polyhaloalkoxy, alkoxy, alkylthio, alkylsulfinyl,  
 alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl  
 provided that at least two ring position pairs  
 selected from 2 of  $Y_{20}$  are halogen;

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(iii)

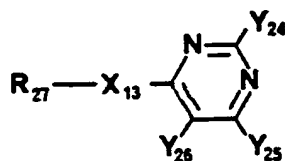
wherein:

$R_{26}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{12}$  represents O, S, SO,  $SO_2$ , NH,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$ , or  $-CONH-$ ;

$Y_{21}$  and  $Y_{22}$  are independently the same or different halogen; and

$Y_{23}$  represents hydrogen, halogen, alkyl, polyhaloalkyl, alkoxy, polyhaloalkoxy, cyano, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl;



(iv)

wherein:

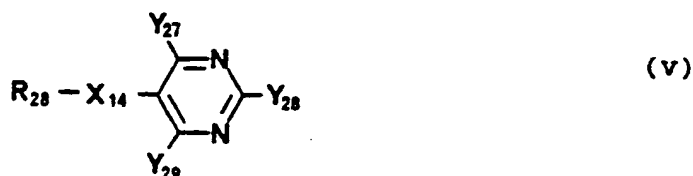
$R_{27}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{13}$  represents O, S, SO,  $SO_2$ , NH,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$ , or  $-CONH-$ ;

$Y_{24}$  represents halogen; and

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$Y_{25}$  and  $Y_{26}$  independently represent hydrogen, halogen, alkyl, polyhaloalkyl, alkoxy, polyhaloalkoxy, cyano, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that at least one of  $Y_{25}$  and  $Y_{26}$  is halogen and further provided that when  $Y_{24}$ ,  $Y_{25}$  and  $Y_{26}$  are chloro and  $X_{13}$  is O, then  $R_{27}$  is not unsubstituted phenyl;



wherein:

$R_{28}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{14}$  represents O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, a single covalent bond, -CH<sub>2</sub>O-, -CH<sub>2</sub>S-, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)-, or -CONH-;

$Y_{27}$  and  $Y_{28}$  are independently halogen;

and

$Y_{29}$  represents hydrogen, halogen, alkyl, polyhaloalkyl, alkoxy, polyhaloalkoxy, cyano, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl;



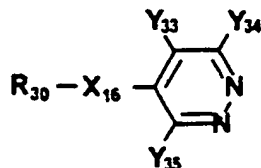
- 242 -

wherein:

$R_{29}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{15}$  represents O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, a single covalent bond, -CH<sub>2</sub>O-, -CH<sub>2</sub>S-, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)-, or -CONH-; and

$Y_{30}$ ,  $Y_{31}$  and  $Y_{32}$  independently represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that at least 2 of  $Y_{30}$ ,  $Y_{31}$  and  $Y_{32}$  are halogen;



(vii)

wherein:

$R_{30}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

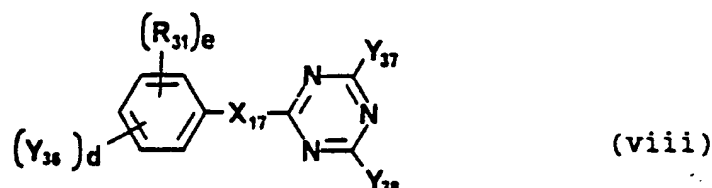
$X_{16}$  represents O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, a single covalent bond, -CH<sub>2</sub>O-, -CH<sub>2</sub>S-, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)-, or -CONH-; and

$Y_{33}$ ,  $Y_{34}$  and  $Y_{35}$  independently represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or



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polyhaloalkylsulfonyl provided that (i) at least 2 of  $Y_{33}$ ,  $Y_{34}$  and  $Y_{35}$  are halogen, (ii) when  $Y_{34}$  and  $Y_{35}$  are both chloro and  $X_{16}$  is O, then  $R_{30}$  is not unsubstituted phenyl, and (iii) when  $Y_{33}$  and  $Y_{34}$  are both chloro and  $X_{16}$  is O, the  $R_{30}$  is not unsubstituted phenyl or 4-methoxyphenyl;



wherein:

$d$  is a value of from 0 to 4 inclusive;

$e$  is a value of 1 or 2 provided that  $d$  and  $e$  are not greater than 5;

$R_{31}$  is the same or different and represents unsubstituted or substituted aryl provided that when  $R_{31}$  is 2- or 4-aryl then  $d$  is not O, aralkyl provided that when  $R_{31}$  is R-aralkyl then  $d$  is not O, alkoxy, cycloalkoxy, aryloxy, aralkoxy provided that when  $R_{31}$  is 4-aralkoxy then  $d$  is not O, arylaryloxy, aralkoxyaralkyl, arylaralkoxy, aryloxyaralkyl, aryloxyalkyl, aryloxyaryloxy, aralkoxyaralkoxy, aryloxyalkoxy, alkylthio, alkenylthio, arylthio, aralkylthio, arylthioaralkyl, arylsulfonylarylsulfonyl, alkylamino, dialkylamino, acyloxy, aroyloxy, alkoxycarbonyloxy, phenylazo provided that  $X_{17}$  is O or S, naphthylazo, or  $-OCH_2O-$  or  $-OCH_2CH_2O-$  which join adjacent carbon atoms to form a five- or six-membered ring;

$Y_{36}$  is the same or different and represents halogen, alkyl, alkenyl, alkynyl,

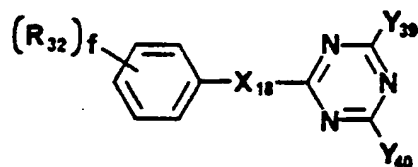
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-CH=CHCH=CH-, which joins adjacent carbon atoms to form a six-membered ring,  $-(CH_2)_4$ , nitro, cyano, haloalkyl, or polyhaloalkyl;

$X_{17}$  represents O, S, NH,  $CH_2$ ,  $-CH_2O-$ ,  $-CH_2S-$  or  $-OCH_2CH_2O-$ ;

$Y_{37}$  represents halogen; and

$Y_{38}$  represents halogen, alkoxy, alkylthio, alkylsulfonyl, polyhaloalkoxy, polyhaloalkyl, cyano, nitro or unsubstituted or substituted arylthio, aryloxy or arylsulfonyl;



(ix)

wherein:

$f$  is a value of from 0 to 5;

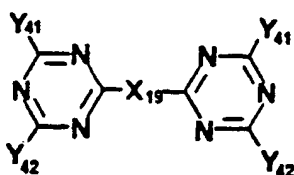
$R_{32}$  is the same or different and represents halogen, alkyl, alkenyl, alkynyl, polyhaloalkyl, cyano, nitro, alkylamino, dialkylamino, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, acyl,  $CO_2(alkyl)$ ,  $CONH(alkyl)$ ,  $CON(alkyl)_2$ ,  $SO_2N(alkyl)_2$ , alkylcarbonyloxy, alkoxycarbonyloxy, or unsubstituted or substituted aryloxy, arylthio, arylsulfonyl or aroyl;

$X_{18}$  represents O, S,  $CH_2$ , a single covalent bond or  $-C\equiv C-$ ;

$Y_{39}$  represents halogen, polyhaloalkoxy, polyhaloalkyl, cyano, alkylsulfonyl, alkylsulfonyloxy, polyhaloalkylsulfonyl or polyhaloalkylsulfonyloxy; and

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$Y_{40}$  represents haloalkyl, polyhaloalkyl, alkoxy provided that  $X_{18}$  is not S or a single covalent bond; polyhaloalkoxy, cyano, alkylthio provided that  $X_{18}$  is not O or a single covalent bond; alkylsulfonyl, nitro, dialkoxyphosphinyl or trialkylammonium;



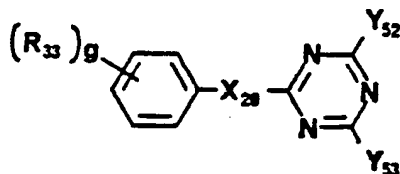
(x)

wherein:

$Y_{41}$  is the same or different and represents halogen;

$Y_{42}$  is the same or different and represents halogen, alkoxy, alkylthio or polyhaloalkoxy; and

$X_{19}$  represents O, dithio,  $-P(=O)(O-alkyl)-$ ,  $-P(alkyl)-$ ,  $-P(O-alkyl)-$ , sulfinyl, sulfonyl, thiosulfinyl, a single covalent bond, carbonyl, aminocarbonylamino, aminooxalyl-amino, aminocarbonylalkylenecarbonylamino, aminoalkyleneamino, unsubstituted or substituted oxyaryloxy provided that 1,3-arylenebis (oxy) is substituted with at least one substituent, oxyaryl-alkylaryloxy, oxyarylthioaryloxy, oxyarylsulfonylaryloxy and oxyarylaryloxy;



(xi)

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wherein:

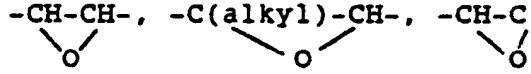
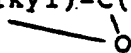
$Y_{52}$  and  $Y_{53}$  are independently halogen;

$g$  is a value of from 0 to 5 inclusive;

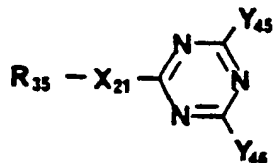
$R_{33}$  is the same or different and represents halogen, alkyl, alkenyl, alkynyl, polyhaloalkyl, cyano, nitro, amino, alkylamino, dialkylamino, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkoxycarbonyl, alkylaminocarbonyl, aminocarbonyl, dialkylaminocarbonyl, dialkylaminosulfonyl, alkylaminosulfonyl, aminosulfonyl, alkylcarbonyl, dialkoxyalkyl, alkylcarbonyloxy, alkylcarbonylalkylamino,  $-\text{CH}=\text{CHCH}=\text{CH}-$  which joins adjacent carbon atoms to form a six-membered ring, or unsubstituted or substituted aryl, aralkyl, aryloxy, arylthio, arylsulfonyl or aralkoxy; and

$X_{20}$  represents  $-\text{CH}(\text{alkyl})\text{O}-$ ,  
 $-\text{C}(\text{alkyl})_2\text{O}-$ ,  $-\text{OCH}_2-$ ,  $-\text{CH}_2\text{O}-$ ,  $-\text{CH}_2-$ ,  
 $-\text{C}(\text{halogen})_2$ ,  $-\text{OCH}_2\text{O}-$ ,  $-\text{OCH}_2\text{CH}_2\text{O}-$  or  $-\text{C}\equiv\text{C}-$   
 provided that  $g$  is a value of at least 1;  
 $-\text{OCH}(\text{alkyl})-$ ,  $-\text{OC}(\text{alkyl})_2$ ,  $-\text{OCH}(\text{alkyl})\text{O}-$ ,  
 $-\text{OC}(\text{alkyl})_2\text{O}-$ ,  $-\text{OCH}(\text{alkyl})\text{CH}_2\text{O}-$ ,  
 $-\text{OCH}(\text{alkyl})\text{CH}(\text{alkyl})\text{O}-$ ,  $-\text{CH}(\text{alkyl})\text{CH}(\text{alkyl})-$ ,  
 $-\text{CH}(\text{alkyl})-$ ,  $-\text{C}(\text{alkyl})_2-$ ,  $-\text{CH}_2\text{CH}_2\text{O}-$ ,  
 $-\text{OCH}_2\text{CH}_2-$ ,  $-\text{CH}(\text{alkyl})\text{CH}_2\text{O}-$ ,  $-\text{CH}_2\text{CH}_2-$ ,  
 $-\text{CH}(\text{CN})\text{O}-$ ,  $-\text{C}(\text{alkyl})(\text{CN})\text{O}-$ ,  $-\text{CH}(\text{polyhaloalkyl})\text{O}-$ ,  
 $-\text{C}(\text{CN})=\text{NO}-$ ,  $-\text{C}(\text{NH alkyl})=\text{NO}-$ ,  $-\text{C}[\text{N}(\text{alkyl})_2]=\text{NO}-$ ,  
 $-\text{C}(\text{S-alkyl})=\text{NO}-$ ,  $-\text{C}(\text{O-alkyl})=\text{NO}-$ ,  $-\text{SC}(=\text{O})\text{O}-$ ,  
 $-\text{NHC}(=\text{O})\text{O}-$ ,  $-\text{N}(\text{alkyl})\text{C}(=\text{O})\text{O}-$ ,  $\text{SO}$ ,  $\text{SO}_2$ ,  
 $-\text{CH}_2\text{S}(\text{O})_h-$ ,  $-\text{CH}(\text{alkyl})\text{S}(\text{O})_h-$ ,  $-\text{S}(\text{O})_h\text{CH}_2-$ ,  
 $-\text{OC}(=\text{S})\text{S}-$ ,  $-\text{C}(=\text{O})\text{S}-$ ,  $-\text{C}(=\text{S})-\text{S}-$ ,  $-\text{NH}(\text{alkyl})\text{C}(=\text{O})\text{S}-$ ,

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$-O(C=O)S-$ ,  $-N(R_{34})-$ ,  $-SO_2NH-$ ,  $-SO_2N(alkyl)-$ ,  
 $-CONH-$ ,  $-CON(alkyl)-$ ,  $-SC(=O)N(alkyl)-$ ,  $-S-C(=O)NH-$ ,  
 $-NHSO_2NH-$ ,  $-N(alkyl)SO_2N(alkyl)-$ ,  
 $-N(alkyl)SO_2NH-$ ,  $-NHSO_2N(alkyl)-$ ,  
 $-C(O-alkyl)=N-$ ,  $-C(S-alkyl)=N-$ ,  $-CH(halogen)-$ ,  
 $-C(alkyl)(halogen)-$ ,  $-CH(CN)-$ ,  $-C(alkyl)(CN)-$ ,  
 $-NH(alkyl)NH-$ ,  $-NH-N(alkyl)-$ ;  $-NH-NH-$  or  $-N=N-$   
 provided that  $R_{33}$  is not nitro;  $-C(=O)-$ ,  
 $-C(=O)C(=O)-$ ,  $-CH(O-alkyl)-$ ,  $-CH_2C(=O)-$ ,  
 $-C(=O)CH_2-$ ,  $-CH(alkyl)C(=O)-$ ,  $-C(=O)CH(alkyl)-$ ,  
 $-CH=CH-$ ,  $-C(alkyl)=CH-$ ,  $-CH=C(alkyl)-$ ,  
 $-C(alkyl)=C(alkyl)-$ ,  $-C(=O)CH=CH-$ ,  
 $-P(Y_{43})(Y_{44}-alkyl)-$ , unsubstituted or  
 substituted  $-P(Y_{43})(Y_{44}-aryl)$  or arylene,  
 $-Si(halogen)_2-$ ,  $-Si(alkyl)_2-$ ,  $-OC(=O)N(alkyl)-$ ,  
 $-OCH_2C(=O)N(alkyl)-$ ,  $-N(alkyl)CON(alkyl)-$ ;  
 $-OC(=O)NH-$ ,  $-NHCONH-$ ,  $-SO_2NHC(=O)NH-$ , or  
 $-NHC(=S)NH$  provided that  $g$  is a value of at least 1;  
 $-CH-CH-$ ,  $-C(alkyl)-CH-$ ,  $-CH-C(alkyl)-$ , or  
  
 $-C(alkyl)-C(alkyl)-$   


wherein  $h$  is a value of from 0 to 2 inclusive,  $R_{34}$   
 represents acyl, alkylsulfonyl, polyhaloalkyl,  
 polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted  
 or substituted aroyl or arylsulfonyl and  $Y_{43}$  and  
 $Y_{44}$  are independently O or S;



(xii)

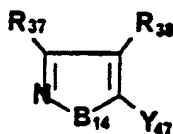
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wherein:

R<sub>35</sub> represents an unsubstituted or substituted heterocyclic ring system selected from isoxazole, isothiazole, pyrazole, imidazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,4,-thiadiazole, 1,3,4-thiadiazole, oxazole, thiazole, benzopyrazole, benzimidazole, benzoxazole, benzothizole, indole, pyrrole, furan, thiophene, benzofuran, benzothiophene, pyridine, pyrimidine, pyridazine, pyrazine, 1,3,5-triazine, 1,2,4-triazine, quinoline, isoquinoline, quinazoline, phthalazine, benzopyridazine, benzopyrazine, carbazole, dibenzofuran, dibenzothiophene, benzoxazine, phthalimide, benzopyran, dibenzopyridine, pyridopyridine, pyrazolopyrimidine, tetrahydropyrimidinedione, coumarin, piperidine, morpholine, tetrahydrofuran, tetrahydrothiophene, pyrrolidine, thiomorpholine, piperidine-2-one, piperidine-2,6-dione, 2,5-pyrrolidinedione, 3-morpholinone, 2-oxohexamethyleneimine, 2-oxotetramethyleneimine, 1-pyrazoline, 2-pyrazoline, pyrazolidine, 2-imidazolidinone, 2-imidazolidinethione, 2,4-imidazolidinedione, 1,2-oxathiolane, 1,3-oxathiolane, 1,3-oxathiane, 1,4-oxathiane, 2(1H)-pyrazinone, 2H-pyran-2-one, 4H-pyran-4-one, 2H-pyran-2-thione, 4H-pyran-4-thione, tetrahydropyran, tetrahydrothiopyran, 7-oxabicyclo[2.2.1]heptane, 7-azabicyclo[2.2.1]heptane, oxetane, coumarin, 1,3-dioxane, 1,4-dioxane or 1,3-dioxolane;

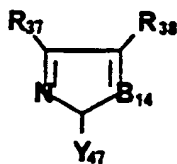
$X_{21}$  represents O, S or NH provided that  
 when  $X_{21}$  is NH then  $R_{35}$  is not pyridine, and  
 when  $X_{21}$  is S then  $R_{35}$  is not unsubstituted  
 benzothiazole; and

$Y_{45}$  and  $Y_{46}$  are independently halogen;



(xiii)

or



(xiv)

wherein:

$R_{37}$  and  $R_{38}$  independently represent  
 halogen, nitro, cyano, polyhaloalkyl,  
 polyhaloalkoxy, alkylsulfonyl,  
 polyhaloalkylsulfonyl, acyl, alkoxycarbonyl,  
 polyhaloalkylsulfonyl or  $R_{39}-X_{22}-$  provided that

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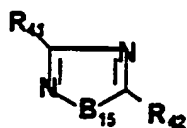
only one of  $R_{37}$  and  $R_{38}$  may be  $R_{39}-X_{22}-$  at any one time;

$R_{39}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{22}$  represents O, S, SO,  $SO_2$ ,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$ , or  $-CONH-$ ;

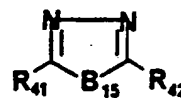
$Y_{47}$  represents halogen; and

$B_{14}$  represents O, S, NH or  $NR_{40}$  wherein  $R_{40}$  represents alkyl, alkylsulfonyl, alkenyl, alkynyl, alkoxycarbonyl; unsubstituted or substituted aryl, aralkyl, aryloxy, arylamino, aroyl or arylsulfonyl; provided that (i) when  $B_{14}$  is  $R_{39}-N<$ ,  $R_{39}-alkyl-N<$ ,  $R_{39}-C(=O)-N<$ ,  $R_{39}-SO_2N<$ ,  $R_{39}-O-N<$  or  $R_{39}-NH-N<$ , then both  $R_{37}$  and  $R_{38}$  are other than  $R_{39}-X_{22}-$ ; (ii) when  $B_{14}$  is other than  $R_{39}-N<$ ,  $R_{39}-alkyl-N<$ ,  $R_{39}-C(=O)-N<$ ,  $R_{39}-SO_2N<$ ,  $R_{39}-O-N<$  or  $R_{39}-NH-N<$ , then one of  $R_{37}$  and  $R_{38}$  is  $R_{39}-X_{22}-$ ; and (iii) when  $R_{38}$  and  $Y_{47}$  are both chlorine and  $X_{22}$  is a single covalent bond in formula (xiii), then  $R_{39}$  is not unsubstituted phenyl;



(xv)

or



(xvi)



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wherein:

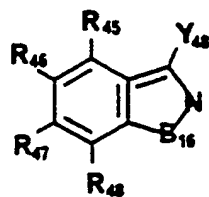
$R_{41}$  and  $R_{42}$  independently represent halogen or  $R_{43}-X_{23}$  provided that only one of  $R_{41}$  and  $R_{42}$  may be  $R_{43}-X_{23}$  at any one time;

$R_{43}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{23}$  represents O, S, SO,  $SO_2$ ,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$ ,  $-CONH-$ ; and

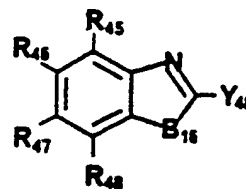
$B_{15}$  represents O, S, NH or  $NR_{44}$  wherein  $R_{44}$  represents alkyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkenyl, alkynyl, alkoxycarbonyl; unsubstituted or substituted aryl, aralkyl, aryloxy, arylamino, aroyl or arylsulfonyl; provided that when  $B_{15}$  is

$R_{43}-N<$ ,  $R_{43}-alkyl-N<$ ,  $R_{43}-C(=O)-N<$ ,  $R_{43}-SO_2N<$ ,  $R_{43}-O-N<$  or  $R_{43}-NH-N<$ , then both  $R_{41}$  and  $R_{42}$  are other than  $R_{43}-X_{23}-$ ; and further provided that when  $B_{15}$  is other than  $R_{43}-N<$ ,  $R_{43}-alkyl-N<$ ,  $R_{43}-C(=O)-N<$ ,  $R_{43}-SO_2N<$ ,  $R_{43}-O-N<$  or  $R_{43}-NH-N<$ , then one of  $R_{41}$  and  $R_{42}$  is  $R_{43}-X_{23}-$ ;



(xvii)

or



(xviii)

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wherein:

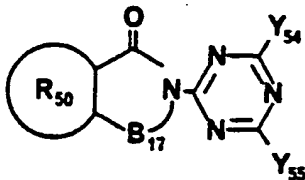
$R_{45}$ ,  $R_{46}$ ,  $R_{47}$ , and  $R_{48}$  independently represent hydrogen, halogen, nitro, cyano, polyhaloalkyl, polyhaloalkoxy, alkylsulfonyl, polyhaloalkylsulfonyl, acyl, alkylthio, alkyl, alkoxy, alkylsulfinyl or  $R_{49}-X_{24}$  provided that one of  $R_{45}$ ,  $R_{46}$ ,  $R_{47}$ , and  $R_{48}$  is  $R_{49}-X_{24}$  and further provided that  $R_{45}$ ,  $R_{46}$ ,  $R_{47}$ , and  $R_{48}$  include no more than two of hydrogen, alkyl or alkoxy at any one time;

$R_{49}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{24}$  represents O, S, SO,  $SO_2$ ,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$ ,  $-CONH-$ ;

$Y_{48}$  represents halogen; and

$B_{16}$  represents O, S or NH;



(xix)

wherein:

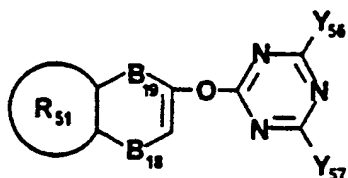
$R_{50}$  represents an unsubstituted or substituted, carbocyclic or heterocyclic ring system

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selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated;

$B_{17}$  represents  $-CH=N-$ ,  $-N=CH-$ ,  $-CH=CH-$ ,  $-CO-$ ,  $-SO_2-$ ,  $-CH_2CO-$ ,  $-COCH_2-$ ,  $-CONH-$ ,  $-NHCO-$ ,  $-SO_2NH-$ ,  $-NHSO_2-$ ,  $-SO_2N(alkyl)-$ ,  $-N(alkyl)SO_2-$ ,  $-OSO_2-$ ,  $-CS-$ ,  $-N<$ ,  $-NH-$ ,  $-N(alkyl)-$ ,  $-OCH_2-$ ,  $-SCH_2-$ ,  $-NHCH_2-$ ,  $-N(alkyl)CH_2-$ ,  $-SCO-$ ,  $-OCH_2-$ ,  $-OCO-$ ,  $-CH_2-$ ,  $-CH_2CH_2-$  or  $-SCH_2CO-$ ; provided that when  $B_{17}$  is  $-CO-$  and  $R_{50}$  is phenyl, then the phenyl is substituted; and

$Y_{54}$  and  $Y_{55}$  are independently halogen;



(xx)

wherein:

$R_{51}$  represents or unsubstituted or substituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring

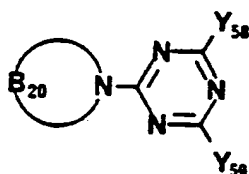
- 254 -

system, and a bridged ring system which may be saturated or unsaturated;

$B_{18}$  represents  $-\text{CH}=\text{N}-$ ,  $-\text{N}=\text{CH}-$ ,  $-\text{CH}=\text{CH}-$ ,  $-\text{CO}-$ ,  $-\text{SO}_2-$ ,  $-\text{CH}_2\text{CO}-$ ,  $-\text{COCH}_2-$ ,  $-\text{CONH}-$ ,  $-\text{NHCO}-$ ,  $-\text{SO}_2\text{NH}-$ ,  $-\text{NHSO}_2-$ ,  $-\text{SO}_2\text{N(alkyl)}-$ ,  $-\text{N(alkyl)SO}_2-$ ,  $-\text{OSO}_2-$ ,  $-\text{CS}-$ ,  $-\text{N(alkyl)}-$ ,  $-\text{NH}-$ ,  $-\text{N(alkyl)}-$ ,  $-\text{OCH}_2-$ ,  $-\text{SCH}_2-$ ,  $-\text{NHCH}_2-$ ,  $-\text{N(alkyl)CH}_2-$ ,  $-\text{S-CO}-$ ,  $-\text{OCH}_2-$ ,  $-\text{OCO}-$ ,  $-\text{CH}_2-$ ,  $-\text{CH}_2\text{CH}_2-$  or  $-\text{SCH}_2\text{CO}-$ ;

$B_{19}$  represents  $-\text{CH}_2-$  or  $-\text{CH(alkyl)}-$ ; and  $i$  is a value of 0 or 1; and

$Y_{56}$  and  $Y_{57}$  are independently halogen;



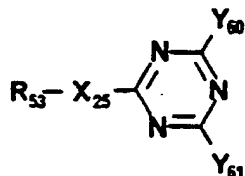
(xxi)

wherein:

$B_{20}$  represents  $-\text{CH}_2\text{C(CH}_3)_2\text{SCH}_2-$ ,  $-\text{CH}_2\text{CH}=\text{C(CH}_3)\text{OCH}_2-$ ,  $-\text{CH}_2\text{CH}_2\text{SCH}_2\text{CH(CH}_3)-$ ,  $-\text{CH}_2\text{CH}_2\text{SCH}_2\text{CH}_2-$ ,  $-\text{CH}_2\text{SCH}_2\text{CO}-$ ,  $-\text{COCH}_2\text{C(CH}_3)_2\text{CH}_2\text{CO}-$ ,  $-\text{COCH}_2\text{CH(C}_6\text{H}_5)\text{CH}_2\text{CO}-$ ,  $-\text{CONH(C}_6\text{H}_5)\text{CH}_2\text{CH}_2\text{O}-$ ,  $-\text{COC(CH}_3)_2\text{NHCO}-$ ,  $-\text{CH}_2\text{CH}_2\text{N(C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$ ,  $-\text{CH}_2\text{N(C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$ ,  $-\text{CH}_2\text{CH}_2\text{CH(C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$ ,  $-\text{CO(CH}_2)_3\text{CO}-$ ,  $-\text{CO(CH}_2)_2\text{CO}-$ ,  $-\text{COCH}_2\text{CH(CH}_3)\text{CH}_2\text{CO}-$ ,  $-\text{COCH(CH}_3)\text{CH}_2\text{CO}-$ ,  $-\text{COC(CH}_3)_2\text{CH}_2\text{CO}-$ ,  $-\text{COC(CH}_3)_2\text{C(CH}_3)_2\text{CO}-$ ,  $-\text{CO(CH}_2)_4\text{CO}-$ .

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$-\text{CO}(\text{CH}_2)_5\text{CO}-$ ,  $-\text{CO}(\text{CH}_2)_5\text{CH}_2-$ ,  
 $-\text{CO}(\text{CH}_2)_4\text{CH}_2-$ ,  $-\text{CO}(\text{CH}_2)_3\text{CH}_2-$ ,  
 $-\text{CO}(\text{CH}_2)_2\text{CH}_2-$ ,  $-\text{COCH}_2\text{SCH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{N}(\text{R}_{52})\text{CH}_2\text{CO}-$ ,  $-\text{COCH}_2\text{OCH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{SCS}-$ ,  $-\text{COCH}=\text{CH}-\text{N}=\text{CH}-$ ,  
 $-\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2-\text{N}=\text{CH}-$ , or  $-\text{CO}_2-\text{CH}_2\text{CH}_2-$ ;  
 $\text{R}_{52}$  represents hydrogen, alkenyl;  
 unsubstituted or substituted aryl or alkaryl; and  
 $\text{Y}_{58}$  and  $\text{Y}_{59}$  are independently halogen;



(xxii)

wherein:

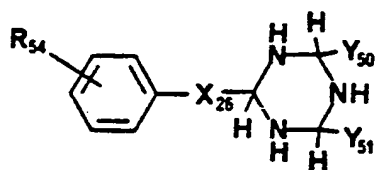
$\text{R}_{53}$  represents unsubstituted or substituted cycloalkenyl, cycloalkadienyl, cycloalkatrienyl, bicycloalkyl, bicycloalkadienyl, tricycloalkyl, bicycloalkenyl, tricycloalkenyl or tricycloalkadienyl in which the permissible substituents are the same or different and are one or more alkyl, halogen, haloalkyl, polyhaloalkyl, alkoxy, alkylthio, alkylsulfonyl, polyhaloalkoxy, nitro, cyano, acyl, aroyl, aryl, alkoxycarbonyl, alkoxycarbonyloxy, acyloxy, oxo, or  $-\text{CH}=\text{CHCH}=\text{CH}-$  or  $-\text{CH}=\text{CHCH}_2-$  which join adjacent carbon atoms to form a six-or five membered ring;

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$Y_{60}$  and  $Y_{61}$  are independently halogen;

and

$X_{25}$  represents O, S, NH,  $CH_2$ ,  $-CH_2O-$  or a single covalent bond;



(xxiii)

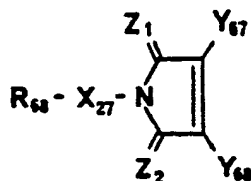
wherein:

$R_{54}$  is the same or different and is one or more hydrogen, halogen, alkyl, aryl, aralkyl, alkenyl, alkynyl, polyhaloalkyl,  $NH_2$ ,  $NH(alkyl)$ ,  $N(alkyl)_2$ , alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, aralkoxy,  $CO_2alkyl$ ,  $CONH(alkyl)$ ,  $CONH_2$ ,  $CON(alkyl)_2$ ,  $SO_2N(alkyl)_2$ ,  $SO_2NH(alkyl)$ ,  $SO_2NH_2$ , acyl,  $CO(O-alkyl)_2$ , acyloxy, acyl- $CON(alkyl)$  or 2,3- $(-CH=CHCH=CH-)$ , 3,4- $(-CH=CHCH=CH-)$ , 2,3- $(CH_2)_4-$  or 3,4- $(CH_2)_4-$  which join the adjacent carbon atoms to form and unsubstituted or substituted six-membered ring;

$X_{26}$  represents O, S,  $SO$ ,  $SO_2$ ,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-OCH_2CH_2-$  or  $-OCH_2-$ ; and

$Y_{50}$  and  $Y_{51}$  are the same or different and are halogen;

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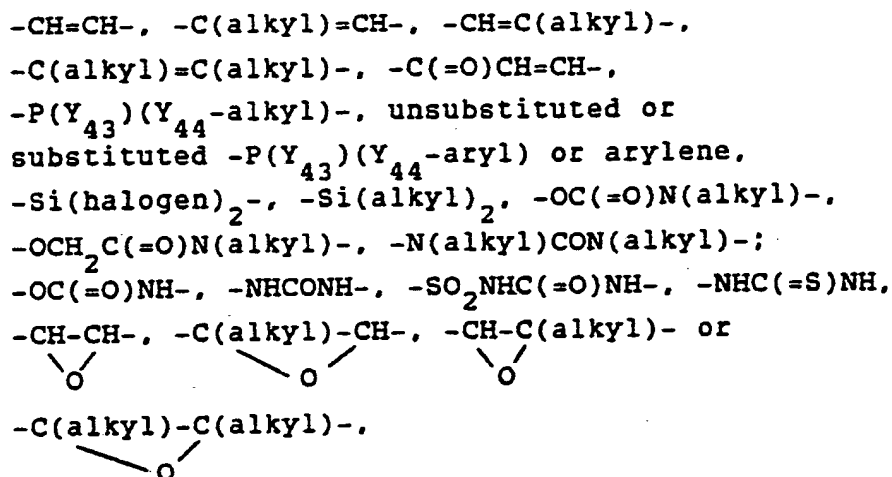


(xxiv)

$R_{68}$  represents unsubstituted or substituted phenyl or 1- or 2-naphthyl;

$X_{27}$  represents -CH(alkyl)O-,  
 -C(alkyl)<sub>2</sub>O-, -OCH<sub>2</sub>-, -C(halogen)<sub>2</sub>-, -OCH<sub>2</sub>O-,  
 -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>O-, -C≡C-, -OCH(alkyl)-,  
 -OC(alkyl)<sub>2</sub>-, -OCH(alkyl)O-, -OC(alkyl)<sub>2</sub>O-,  
 -OCH(alkyl)CH<sub>2</sub>O-, -OCH(alkyl)CH(alkyl)O-,  
 -CH(alkyl)CH(alkyl)-, -CH(alkyl)-, -C(alkyl)<sub>2</sub>-,  
 -CH<sub>2</sub>CH<sub>2</sub>O-, -OCH<sub>2</sub>CH<sub>2</sub>-, -CH(alkyl)CH<sub>2</sub>O-,  
 -CH<sub>2</sub>CH<sub>2</sub>-, -CH(CN)O-, -C(alkyl)(CN)O-,  
 -CH(polyhaloalkyl)O-, -C(CN)=NO-, -C(NH alkyl)=NO-,  
 -C[N(alkyl)<sub>2</sub>]=NO-, -C(S-alkyl)=NO-,  
 -C(O-alkyl)=NO-, -SC(=O)O-, -NHC(=O)O-,  
 -N(alkyl)C(=O)O-, SO, SO<sub>2</sub>, -CH<sub>2</sub>S(O)<sub>h</sub>-,  
 -CH(alkyl)S(O)<sub>h</sub>-, -S(O)<sub>h</sub>CH<sub>2</sub>-, -OC(=S)S-,  
 -C(=O)S-, -C(=S)-S-, -NH(alkyl)C(=O)S-, -O(C=O)S-,  
 -N(alkyl)-, -N(R<sub>34</sub>)-, -SO<sub>2</sub>NH-, -SO<sub>2</sub>N(alkyl)-,  
 -CONH-, -CON(alkyl)-, -SC(=O)N(alkyl)-, -S-C(=O)NH-,  
 -NHSO<sub>2</sub>NH-, -N(alkyl)SO<sub>2</sub>N(alkyl)-,  
 -N(alkyl)SO<sub>2</sub>NH-, -NHSO<sub>2</sub>N(alkyl)-,  
 -C(O-alkyl)=N-, -C(S-alkyl)=N-, -CH(halogen)-,  
 -C(alkyl)(halogen)-, -CH(CN)-, -C(alkyl)(CN)-,  
 -NH(alkyl)NH-, -NH-N(alkyl)-; -NH-NH-, -N=N-,  
 -C(=O)-, -C(=O)C(=O)-, -CH(O-alkyl)-, -CH<sub>2</sub>C(=O)-,  
 -C(=O)CH<sub>2</sub>-, -CH(alkyl)C(=O)-, -C(=O)CH(alkyl)-,

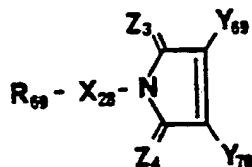
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wherein  $h$  is a value of from 0 to 2 inclusive,  $\text{R}_{34}$  represents acyl, alkylsulfonyl, polyhaloalkyl, polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted or substituted aroyl or arylsulfonyl and  $\text{Y}_{43}$  and  $\text{Y}_{44}$  are independently O or S;

$\text{Z}_1$  and  $\text{Z}_2$  are independently O, S,  $\text{C}_1-\text{C}_8$  alkylidene, substituted or unsubstituted benzylidene, NH or  $\text{NR}'''$  wherein  $\text{R}'''$  is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

$\text{Y}_{67}$  and  $\text{Y}_{68}$  are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, aryl, polyhaloalkylsulfonyl, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, phosphono or phosphino;



(xxv)



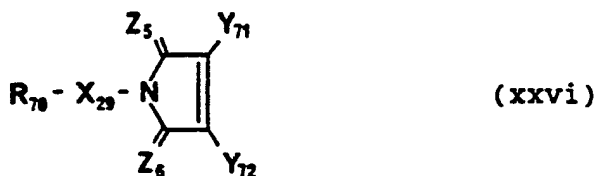
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$R_{69}$  represents unsubstituted or substituted phenyl or 1- or 2-naphthyl;

$X_{28}$  is NH,  $CH_2$  or a covalent bond;

$Z_3$  and  $Z_4$  are independently O, S,  $C_1-C_8$  alkylidene, substituted or unsubstituted benzylidene, NH or  $NR'''$  wherein  $R'''$  is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

$Y_{69}$  and  $Y_{70}$  are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, aryl, polyhaloalkylsulfonyl, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, phosphono or phosphino, with the proviso that  $Y_{69}$  and  $Y_{70}$  taken together do not represent either the same halogen or halogen and hydrogen;



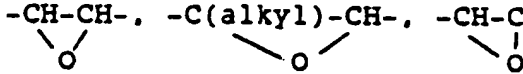
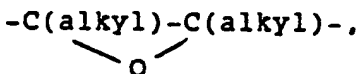
$R_{70}$  represents an unsubstituted or substituted, unsaturated or saturated, aromatic or non-aromatic heterocyclic ring system selected from isoxazole, isothiazole, pyrazole, imidazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,4,-thiadiazole, 1,3,4-thiadiazole, oxazole, thiazole, benzopyrazole, benzimidazole, benzoxazole, benzothiazole, indole, pyrrole, furan, thiophene,

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benzofuran, benzothiophene, pyridine, pyrimidine,  
 pyridazine, pyrazine, 1,3,5-triazine,  
 1,2,4-triazine, quinoline, isoquinoline,  
 quinazoline, phthalazine, benzopyridazine,  
 benzopyrazine, carbazole, dibenzofuran,  
 dibenzothiophene, benzoxazine, phthalimide,  
 benzopyran, dibenzopyridine, pyridopyridine,  
 pyrazolopyrimidine, tetrahydropyrimidinedione,  
 piperidine, morpholine, tetrahydrofuran,  
 tetrahydrothiophene, pyrrolidine, thiomorpholine,  
 piperidine-2-one, piperidine-2,6-dione,  
 2,5-pyrrolidinedione, 3-morpholinone,  
 2-oxohexamethyleneimine, 2-oxotetramethyleneimine,  
 1-pyrazoline, 2-pyrazoline, pyrazolidine,  
 2-imidazolidinone, 2-imidazolidinethione,  
 2,4-imidazolidinedione, 1,2-oxathiolane,  
 1,3-oxathiolane, 1,3-oxathiane, 1,4-oxathiane,  
 2(1H)-pyrazinone, 2H-pyran-2-one, 4H-pyran-4-one,  
 2H-pyran-2-thione, 4H-pyran-4-thione,  
 tetrahydropyran, tetrahydrothiopyran,  
 7-oxabicyclo[2.2.1]heptane,  
 7-azabicyclo[2.2.1]heptane, oxetane, coumarin,  
 1,3-dioxane, 1,4-dioxane or 1,3-dioxolane;

$X_{29}$  represents -CH(alkyl)O-,  
 -C(alkyl)<sub>2</sub>O-, -OCH<sub>2</sub>-, -CH<sub>2</sub>O-, -CH<sub>2</sub>-, a  
 covalent bond, -C(halogen)<sub>2</sub>-, -OCH<sub>2</sub>O-,  
 -OCH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-, -OCH(alkyl)-, -OC(alkyl)<sub>2</sub>-,  
 -OCH(alkyl)O-, -OC(alkyl)<sub>2</sub>O-, -OCH(alkyl)CH<sub>2</sub>O-,  
 -OCH(alkyl)CH(alkyl)O-, -CH(alkyl)CH(alkyl)-,  
 -CH(alkyl)-, -C(alkyl)<sub>2</sub>-, -CH<sub>2</sub>CH<sub>2</sub>O-,  
 -OCH<sub>2</sub>CH<sub>2</sub>-, -CH(alkyl)CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-,  
 -CH(CN)O-, -C(alkyl)(CN)O-, -CH(polyhaloalkyl)O-.

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$-\text{C}(\text{CN})=\text{NO}-$ ,  $-\text{C}(\text{NH alkyl})=\text{NO}-$ ,  $-\text{C}[\text{N}(\text{alkyl})_2]=\text{NO}-$ ,  
 $-\text{C}(\text{S-alkyl})=\text{NO}-$ ,  $-\text{C}(\text{O-alkyl})=\text{NO}-$ ,  $-\text{SC}(=\text{O})\text{O}-$ ,  
 $-\text{NHC}(=\text{O})\text{O}-$ ,  $-\text{N}(\text{alkyl})\text{C}(=\text{O})\text{O}-$ ,  $\text{SO}$ ,  $\text{SO}_2$ ,  
 $-\text{CH}_2\text{S}(\text{O})_h-$ ,  $-\text{CH}(\text{alkyl})\text{S}(\text{O})_h-$ ,  $-\text{S}(\text{O})_h\text{CH}_2-$ ,  
 $-\text{OC}(=\text{S})\text{S}-$ ,  $-\text{C}(=\text{O})\text{S}-$ ,  $-\text{C}(=\text{S})-\text{S}-$ ,  $-\text{NH}(\text{alkyl})\text{C}(=\text{O})\text{S}-$ ,  
 $-\text{O}(\text{C}=\text{O})\text{S}-$ ,  $-\text{NH}-$ ,  $-\text{N}(\text{alkyl})-$ ,  $-\text{N}(\text{R}_{34})-$ ,  $-\text{SO}_2\text{NH}-$ ,  
 $-\text{SO}_2\text{N}(\text{alkyl})-$ ,  $-\text{CONH}-$ ,  $-\text{CON}(\text{alkyl})-$ ,  
 $-\text{SC}(=\text{O})\text{N}(\text{alkyl})-$ ,  $-\text{S}-\text{C}(=\text{O})\text{NH}-$ ,  $-\text{NHSO}_2\text{NH}-$ ,  
 $-\text{N}(\text{alkyl})\text{SO}_2\text{N}(\text{alkyl})-$ ,  $-\text{N}(\text{alkyl})\text{SO}_2\text{NH}-$ ,  
 $-\text{NHSO}_2\text{N}(\text{alkyl})-$ ,  $-\text{C}(\text{O-alkyl})=\text{N}-$ ,  $-\text{C}(\text{S-alkyl})=\text{N}-$ ,  
 $-\text{CH}(\text{halogen})-$ ,  $-\text{C}(\text{alkyl})(\text{halogen})-$ ,  $-\text{CH}(\text{CN})-$ ,  
 $-\text{C}(\text{alkyl})(\text{CN})-$ ,  $-\text{NH}(\text{alkyl})\text{NH}-$ ,  $-\text{NH}-\text{N}(\text{alkyl})-$ ;  
 $-\text{NH}-\text{NH}-$ ,  $-\text{N}=\text{N}-$ ,  $-\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{C}(=\text{O})-$ ,  
 $-\text{CH}(\text{O-alkyl})-$ ,  $-\text{CH}_2\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{CH}_2-$ ,  
 $-\text{CH}(\text{alkyl})\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{CH}(\text{alkyl})-$ ,  $-\text{CH}=\text{CH}-$ ,  
 $-\text{C}(\text{alkyl})=\text{CH}-$ ,  $-\text{CH}=\text{C}(\text{alkyl})-$ ,  $-\text{C}(\text{alkyl})=\text{C}(\text{alkyl})-$ ,  
 $-\text{C}(=\text{O})\text{CH}=\text{CH}-$ ,  $-\text{P}(\text{Y}_{43})(\text{Y}_{44}-\text{alkyl})-$ , unsubstituted  
or substituted  $-\text{P}(\text{Y}_{43})(\text{Y}_{44}-\text{aryl})$  or arylene,  
 $-\text{Si}(\text{halogen})_2-$ ,  $-\text{Si}(\text{alkyl})_2$ ,  $-\text{OC}(=\text{O})\text{N}(\text{alkyl})-$ ,  
 $-\text{OCH}_2\text{C}(=\text{O})\text{N}(\text{alkyl})-$ ,  $-\text{N}(\text{alkyl})\text{CON}(\text{alkyl})-$ ;  
 $-\text{OC}(=\text{O})\text{NH}-$ ,  $-\text{NHCONH}-$ ,  $-\text{SO}_2\text{NHC}(=\text{O})\text{NH}-$ ,  $-\text{NHC}(=\text{S})\text{NH}-$ ,  
 $-\text{CH}-\text{CH}-$ ,  $-\text{C}(\text{alkyl})-\text{CH}-$ ,  $-\text{CH}-\text{C}(\text{alkyl})-$  or  
  
 $-\text{C}(\text{alkyl})-\text{C}(\text{alkyl})-$ ,  


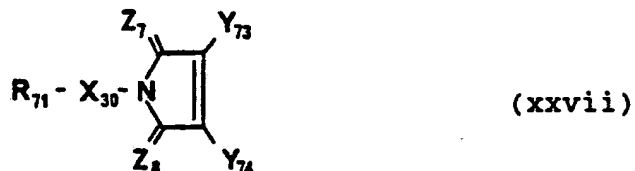
wherein  $h$  is a value of from 0 to 2 inclusive,  $\text{R}_{34}$   
 represents acyl, alkylsulfonyl, polyhaloalkyl,  
 polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted  
 or substituted aroyl or arylsulfonyl and  $\text{Y}_{43}$  and  
 $\text{Y}_{44}$  are independently O or S;

$\text{Z}_5$  and  $\text{Z}_6$  are independently O, S,  
 $\text{C}_1-\text{C}_8$  alkylidene, substituted or unsubstituted

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benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

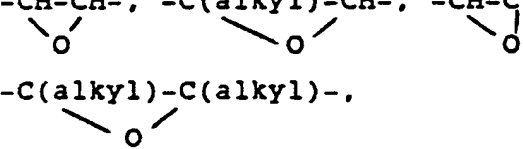
$Y_{71}$  and  $Y_{72}$  are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl, amino, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, alkoxycarbonyl, alkylaminocarbonyl, aminocarbonyl, dialkylaminocarbonyl, dialkylaminosulfonyl, alkylaminosulfonyl, aminosulfonyl, dialkoxyalkyl, arylsulfonyl, phosphono or phosphino;



$R_{71}$  represents unsubstituted or substituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkadienyl, cycloalkatrienyl, bicycloalkyl, bicycloalkenyl, bicycloalkadienyl, tricycloalkyl, tricycloalkenyl or tricycloalkadienyl;

$X_{30}$  represents  $-\text{CH}(\text{alkyl})\text{O}-$ ,  $-\text{C}(\text{alkyl})_2\text{O}-$ ,  $-\text{OCH}_2-$ ,  $-\text{CH}_2\text{O}-$ ,  $-\text{CH}_2-$ , a covalent bond,  $-\text{C}(\text{halogen})_2$ ,  $-\text{OCH}_2\text{O}-$ ,  $-\text{OCH}_2\text{CH}_2\text{O}-$ ,  $-\text{C}\equiv\text{C}-$ ,  $-\text{OCH}(\text{alkyl})-$ ,  $-\text{OC}(\text{alkyl})_2$ ,  $-\text{OCH}(\text{alkyl})\text{O}-$ ,  $-\text{OC}(\text{alkyl})_2\text{O}-$ ,  $-\text{OCH}(\text{alkyl})\text{CH}_2\text{O}-$ ,  $-\text{OCH}(\text{alkyl})\text{CH}(\text{alkyl})\text{O}-$ ,  $-\text{CH}(\text{alkyl})\text{CH}(\text{alkyl})-$ ,  $-\text{CH}(\text{alkyl})-$ ,  $-\text{C}(\text{alkyl})_2-$ ,  $-\text{CH}_2\text{CH}_2\text{O}-$ ,  $-\text{OCH}_2\text{CH}_2-$ ,  $-\text{CH}(\text{alkyl})\text{CH}_2\text{O}-$ ,  $-\text{CH}_2\text{CH}_2-$ ,  $-\text{CH}(\text{CN})\text{O}-$ ,  $-\text{C}(\text{alkyl})(\text{CN})\text{O}-$ ,  $-\text{CH}(\text{polyhaloalkyl})\text{O}-$ ;

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$-\text{C}(\text{CN})=\text{NO}-$ ,  $-\text{C}(\text{NH alkyl})=\text{NO}-$ ,  $-\text{C}[\text{N}(\text{alkyl})_2]=\text{NO}-$ ,  
 $-\text{C}(\text{S-alkyl})=\text{NO}-$ ,  $-\text{C}(\text{O-alkyl})=\text{NO}-$ ,  $-\text{SC}(=\text{O})\text{O}-$ ,  
 $-\text{NHC}(=\text{O})\text{O}-$ ,  $-\text{N}(\text{alkyl})\text{C}(=\text{O})\text{O}-$ ,  $\text{SO}$ ,  $\text{SO}_2$ ,  
 $-\text{CH}_2\text{S}(\text{O})_h-$ ,  $-\text{CH}(\text{alkyl})\text{S}(\text{O})_h-$ ,  $-\text{S}(\text{O})_h\text{CH}_2-$ ,  
 $-\text{OC}(=\text{S})\text{S}-$ ,  $-\text{C}(=\text{O})\text{S}-$ ,  $-\text{C}(=\text{S})-\text{S}-$ ,  $-\text{NH}(\text{alkyl})\text{C}(=\text{O})\text{S}-$ ,  
 $-\text{O}(\text{C}=\text{O})\text{S}-$ ,  $-\text{NH}-$ ,  $-\text{N}(\text{alkyl})-$ ,  $-\text{N}(\text{R}_{34})-$ ,  $-\text{SO}_2\text{NH}-$ ,  
 $-\text{SO}_2\text{N}(\text{alkyl})-$ ,  $-\text{CONH}-$ ,  $-\text{CON}(\text{alkyl})-$ ,  
 $-\text{SC}(=\text{O})\text{N}(\text{alkyl})-$ ,  $-\text{S}-\text{C}(=\text{O})\text{NH}-$ ,  $-\text{NHSO}_2\text{NH}-$ ,  
 $-\text{N}(\text{alkyl})\text{SO}_2\text{N}(\text{alkyl})-$ ,  $-\text{N}(\text{alkyl})\text{SO}_2\text{NH}-$ ,  
 $-\text{NHSO}_2\text{N}(\text{alkyl})-$ ,  $-\text{C}(\text{O-alkyl})=\text{N}-$ ,  $-\text{C}(\text{S-alkyl})=\text{N}-$ ,  
 $-\text{CH}(\text{halogen})-$ ,  $-\text{C}(\text{alkyl})(\text{halogen})-$ ,  $-\text{CH}(\text{CN})-$ ,  
 $-\text{C}(\text{alkyl})(\text{CN})-$ ,  $-\text{NH}(\text{alkyl})\text{NH}-$ ,  $-\text{NH}-\text{N}(\text{alkyl})-$ ;  
 $-\text{NH}-\text{NH}-$ ,  $-\text{N}=\text{N}-$ ,  $-\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{C}(=\text{O})-$ ,  
 $-\text{CH}(\text{O-alkyl})-$ ,  $-\text{CH}_2\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{CH}_2$ ,  
 $-\text{CH}(\text{alkyl})\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{CH}(\text{alkyl})-$ ,  $-\text{CH}=\text{CH}-$ ,  
 $-\text{C}(\text{alkyl})=\text{CH}-$ ,  $-\text{CH}=\text{C}(\text{alkyl})-$ ,  $-\text{C}(\text{alkyl})=\text{C}(\text{alkyl})-$ ,  
 $-\text{C}(=\text{O})\text{CH}=\text{CH}-$ ,  $-\text{P}(\text{Y}_{43})(\text{Y}_{44}-\text{alkyl})-$ , unsubstituted  
or substituted  $-\text{P}(\text{Y}_{43})(\text{Y}_{44}-\text{aryl})$  or arylene,  
 $-\text{Si}(\text{halogen})_2-$ ,  $-\text{Si}(\text{alkyl})_2$ ,  $-\text{OC}(=\text{O})\text{N}(\text{alkyl})-$ ,  
 $-\text{OCH}_2\text{C}(=\text{O})\text{N}(\text{alkyl})-$ ,  $-\text{N}(\text{alkyl})\text{CON}(\text{alkyl})-$ ;  
 $-\text{OC}(=\text{O})\text{NH}-$ ,  $-\text{NHCONH}-$ ,  $-\text{SO}_2\text{NHC}(=\text{O})\text{NH}-$ ,  $-\text{NHC}(=\text{S})\text{NH}$   
 $-\text{CH}-\text{CH}-$ ,  $-\text{C}(\text{alkyl})-\text{CH}-$ ,  $-\text{CH}-\text{C}(\text{alkyl})-$  or  
  
 $-\text{C}(\text{alkyl})-\text{C}(\text{alkyl})-$ ,

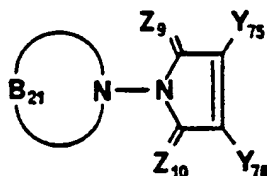
wherein  $h$  is a value of from 0 to 2 inclusive,  $\text{R}_{34}$   
 represents acyl, alkylsulfonyl, polyhaloalkyl,  
 polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted  
 or substituted aroyl or arylsulfonyl and  $\text{Y}_{43}$  and  
 $\text{Y}_{44}$  are independently O or S;

$\text{Z}_7$  and  $\text{Z}_8$  are independently O, S,  
 $\text{C}_1-\text{C}_8$  alkylidene, substituted or unsubstituted

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benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

$Y_{73}$  and  $Y_{74}$  are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, aryl, polyhaloalkylsulfonyl, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy and polyhaloalkylsulfonyloxy;



(xxviii)

wherein:

$B_{21}$  represents  $-\text{CH}_2\text{C}(\text{CH}_3)_2\text{SCH}_2-$ ,  
 $-\text{CH}_2\text{CH}=\text{C}(\text{CH}_3)\text{OCH}_2-$ ,  
 $-\text{CH}_2\text{CH}_2\text{SCH}_2\text{CH}(\text{CH}_3)-$ ,  
 $-\text{CH}_2\text{CH}_2\text{SCH}_2\text{CH}_2-$ ,  $-\text{CH}_2\text{SCH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2\text{CO}-$ ,  
 $-\text{CONH}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2\text{O}-$ ,  $-\text{COC}(\text{CH}_3)_2\text{NHCO}-$ ,  
 $-\text{CH}_2\text{CH}_2\text{N}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$ ,  
 $-\text{CH}_2\text{N}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$ ,  
 $-\text{CH}_2\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$ ,  
 $-\text{CO}(\text{CH}_2)_3\text{CO}-$ ,  $-\text{CO}(\text{CH}_2)_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CO}-$ ,  $-\text{COCH}(\text{CH}_3)\text{CH}_2\text{CO}-$ ,  
 $-\text{COC}(\text{CH}_3)_2\text{CH}_2\text{CO}-$ ,  
 $-\text{COC}(\text{CH}_3)_2\text{C}(\text{CH}_3)_2\text{CO}-$ ,  $-\text{CO}(\text{CH}_2)_4\text{CO}-$ ,  
 $-\text{CO}(\text{CH}_2)_5\text{CO}-$ ,  $-\text{CO}(\text{CH}_2)_5\text{CH}_2-$ ,  
 $-\text{CO}(\text{CH}_2)_4\text{CH}_2-$ ,  $-\text{CO}(\text{CH}_2)_3\text{CH}_2-$ .

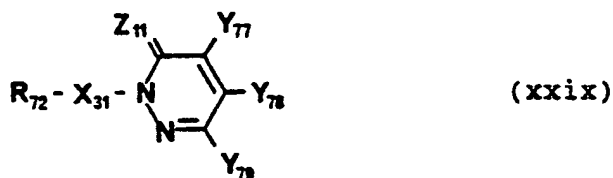
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$-\text{CO}(\text{CH}_2)_2\text{CH}_2-$ ,  $-\text{COCH}_2\text{SCH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{N}(\text{R}_{52})\text{CH}_2\text{CO}-$ ,  $-\text{COCH}_2\text{OCH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{SCS}-$ ,  $-\text{COCH}=\text{CH}-\text{N}=\text{CH}-$ ,  
 $-\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2-\text{N}=\text{CH}-$  or  $-\text{CO}_2-\text{CH}_2\text{CH}_2-$   
 wherein  $\text{R}_{52}$  represents hydrogen, alkenyl;

unsubstituted or substituted aryl or alkaryl;

$\text{Z}_9$  and  $\text{Z}_{10}$  are independently O, S,  
 $\text{C}_1-\text{C}_8$  alkylidene, substituted or unsubstituted  
 benzylidene, NH or  $\text{NR}'''$  wherein  $\text{R}'''$  is alkyl,  
 aryl, aralkyl, alkenyl or alkynyl; and

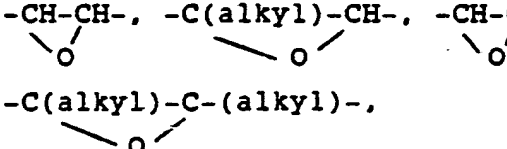
$\text{Y}_{75}$  and  $\text{Y}_{76}$  are the same or different  
 and represent hydrogen, halogen, alkyl, cyano,  
 polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl,  
 alkylthio, alkylsulfinyl, alkylsulfonyl, nitro,  
 acyl, polyhaloalkylsulfonyl, amino, alkylamino,  
 dialkylamino, acylamino, acyloxy, alkylsulfonyloxy,  
 arylsulfonyloxy, alkenylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 phosphono or phosphino;



$\text{R}_{72}$  represents unsubstituted or  
 substituted phenyl or 1- or 2-naphthyl;

$\text{X}_{31}$  represents  $-\text{OCH}_2-$ ,  $-\text{CH}_2-$ , a  
 covalent bond,  $-\text{C}(\text{halogen})_2$ ,  $-\text{C}\equiv\text{C}-$ ,  $-\text{OCH}(\text{alkyl})-$ ,  
 $-\text{OC}(\text{alkyl})_2$ ,  $-\text{CH}(\text{alkyl})\text{CH}(\text{alkyl})-$ ,  $-\text{CH}(\text{alkyl})-$ ,  
 $-\text{C}(\text{alkyl})_2-$ ,  $-\text{OCH}_2\text{CH}_2-$ ,  $-\text{CH}_2\text{CH}_2-$ , SO,  $-\text{S}-$ ,  
 $\text{SO}_2$ ,  $-\text{CH}_2\text{S}(\text{O})_h-$ ,  $-\text{CH}(\text{alkyl})\text{S}(\text{O})_h-$ ,  
 $-\text{S}(\text{O})_h\text{CH}_2-$ ,  $-\text{CH}(\text{halogen})-$ ,  $-\text{C}(\text{alkyl})(\text{halogen})$ .

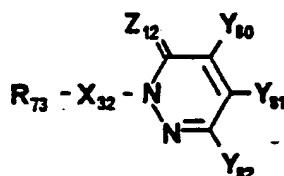
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$-\text{CH}(\text{CN})-$ ,  $-\text{C}(\text{alkyl})(\text{CN})-$ , or  $-\text{C}(=\text{O})-$ ,  $-\text{CH}(\text{O-alkyl})-$ ,  
 $-\text{CH}_2\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{CH}_2-$ ,  $-\text{CH}(\text{alkyl})\text{C}(=\text{O})-$ ,  
 $-\text{C}(=\text{O})\text{CH}(\text{alkyl})-$ ,  $-\text{CH}=\text{CH}-$ ,  $-\text{C}(\text{alkyl})=\text{CH}-$ ,  
 $-\text{CH}=\text{C}(\text{alkyl})-$ ,  $-\text{C}(\text{alkyl})=\text{C}(\text{alkyl})-$ ,  $-\text{C}(=\text{O})\text{CH}=\text{CH}-$ ,  
 arylene,  $-\text{Si}(\text{halogen})_2-$ ,  $-\text{Si}(\text{alkyl})_2-$ ,  
 $-\text{CH}-\text{CH}-$ ,  $-\text{C}(\text{alkyl})-\text{CH}-$ ,  $-\text{CH}-\text{C}(\text{alkyl})-$  or  
  
 $-\text{C}(\text{alkyl})-\text{C}(\text{alkyl})-$ ,

wherein h is a value of from 0 to 2 inclusive;

$Z_{11}$  represents O, S,  $\text{C}_1-\text{C}_8$   
 alkylidene, substituted or unsubstituted  
 benzylidene, NH or  $\text{NR}'''$  wherein  $\text{R}'''$  is alkyl,  
 aryl, aralkyl, alkenyl or alkynyl; and

$Y_{77}$ ,  $Y_{78}$  and  $Y_{79}$  are the same or  
 different and represent hydrogen, halogen, alkyl,  
 hydroxy, cyano, polyhaloalkyl, alkoxy,  
 polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl,  
 alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl,  
 alkylamino, amino, dialkylamino, acylamino, acyloxy,  
 alkylsulfonyloxy, arylsulfonyloxy,  
 alkenylsulfonyloxy, haloalkylsulfonyloxy,  
 polyhaloalkylsulfonyloxy, phosphono or phosphino,  
 with the proviso that when  $Y_{77}$  is halogen and  
 $Y_{79}$  is hydrogen then  $Y_{78}$  cannot be amino,  
 alkylamino, dialkylamino or acylamino and with the  
 further proviso that when  $Y_{77}$  and  $Y_{78}$  are the  
 same halogen then  $Y_{79}$  cannot be hydrogen or  
 hydroxy;



(xxx)

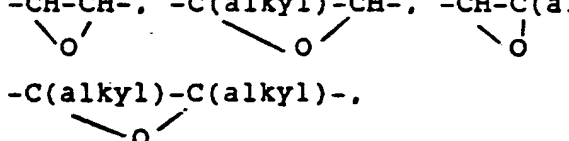


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R<sub>73</sub> represents an unsubstituted or substituted, unsaturated or saturated, aromatic or non-aromatic heterocyclic ring system selected from isoxazole, isothiazole, pyrazole, imidazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,4,-thiadiazole, 1,3,4-thiadiazole, oxazole, thiazole, benzopyrazole, benzimidazole, benzoxazole, benzothiazole, indole, pyrrole, furan, thiophene, benzofuran, benzothiophene, pyridine, pyrimidine, pyridazine, pyrazine, 1,3,5-triazine, 1,2,4-triazine, quinoline, isoquinoline, quinazoline, phthalazine, benzopyridazine, benzopyrazine, carbazole, dibenzofuran, dibenzothiophene, benzoxazine, phthalimide, benzopyran, dibenzopyridine, pyridopyridine, pyrazolopyrimidine, tetrahydropyrimidinedione, piperidine, morpholine, tetrahydrofuran, tetrahydrothiophene, pyrrolidine, thiomorpholine, piperidine-2-one, piperidine-2,6-dione, 2,5-pyrrolidinedione, 3-morpholinone, 2-oxohexamethyleneimine, 2-oxotetramethyleneimine, 1-pyrazoline, 2-pyrazoline, pyrazolidine, 2-imidazolidinone, 2-imidazolidinethione, 2,4-imidazolidinedione, 1,2-oxathiolane, 1,3-oxathiolane, 1,3-oxathiane, 1,4-oxathiane, 2(1H)-pyrazinone, 2H-pyran-2-one, 4H-pyran-4-one, 2H-pyran-2-thione, 4H-pyran-4-thione, tetrahydropyran, tetrahydrothiopyran, 7-oxabicyclo[2.2.1]heptane, 7-azabicyclo[2.2.1]heptane, oxetane, coumarin, 1,3-dioxane, 1,4-dioxane or 1,3-dioxolane;

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$X_{32}$  represents  $-OCH_2-$ ,  $-CH_2-$ , a covalent bond,  $-C(halogen)_2$ ,  $-C\equiv C-$ ,  $-OCH(alkyl)-$ ,  $-OC(alkyl)_2$ ,  $-CH(alkyl)CH(alkyl)-$ ,  $-CH(alkyl)-$ ,  $-C(alkyl)_2-$ ,  $-OCH_2CH_2-$ ,  $-CH_2CH_2-$ ,  $SO$ ,  $-S-$ ,  $SO_2$ ,  $-CH_2S(O)_h-$ ,  $-CH(alkyl)S(O)_h-$ ,  $-S(O)_hCH_2-$ ,  $-CH(halogen)-$ ,  $-C(alkyl)(halogen)-$ ,  $-CH(CN)-$ ,  $-C(alkyl)(CN)-$ ,  $-C(=O)-$ ,  $-CH(O-alkyl)-$ ,  $-CH_2C(=O)-$ ,  $-C(=O)CH_2$ ,  $-CH(alkyl)C(=O)-$ ,  $-C(=O)CH(alkyl)-$ ,  $-CH=CH-$ ,  $-C(alkyl)=CH-$ ,  $-CH=C(alkyl)-$ ,  $-C(alkyl)=C(alkyl)-$ ,  $-C(=O)CH=CH-$ , arylene,  $-Si(halogen)_2-$ ,  $-Si(alkyl)_2$ ,  $-CH-CH-$ ,  $-C(alkyl)-CH-$ ,  $-CH-C(alkyl)-$  or



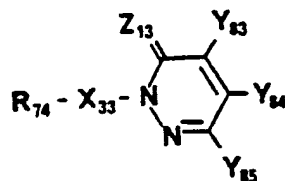
$-C(alkyl)-C(alkyl)-$ .

wherein  $h$  is a value of from 0 to 2 inclusive;

$Z_{12}$  represents  $O$ ,  $S$ ,  $C_1-C_8$  alkylidene, substituted or unsubstituted benzylidene,  $NH$  or  $NR'''$  wherein  $R'''$  is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

$Y_{80}$ ,  $Y_{81}$  and  $Y_{82}$  are the same or different and represent hydrogen, halogen, alkyl, hydroxy, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl, alkylamino, amino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, phosphono or phosphino;

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(xxxi)

$\text{R}_{74}$  represents unsubstituted or substituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkadienyl, cycloalkatrienyl, bicycloalkyl, bicycloalkenyl, bicycloalkadienyl, tricycloalkyl, tricycloalkenyl or tricycloalkadienyl;

$\text{X}_{33}$  represents  $-\text{OCH}_2-$ ,  $-\text{CH}_2-$ , a covalent bond,  $-\text{C}(\text{halogen})_2$ ,  $-\text{C}\equiv\text{C}-$ ,  $-\text{OCH}(\text{alkyl})-$ ,  $-\text{OC}(\text{alkyl})_2$ ,  $-\text{CH}(\text{alkyl})\text{CH}(\text{alkyl})-$ ,  $-\text{CH}(\text{alkyl})-$ ,  $-\text{C}(\text{alkyl})_2-$ ,  $-\text{OCH}_2\text{CH}_2-$ ,  $-\text{CH}_2\text{CH}_2-$ ,  $\text{SO}$ ,  $-\text{S}-$ ,  $\text{SO}_2$ ,  $-\text{CH}_2\text{S}(\text{O})_h-$ ,  $-\text{CH}(\text{alkyl})\text{S}(\text{O})_h-$ ,  $-\text{S}(\text{O})_h\text{CH}_2-$ ,  $-\text{CH}(\text{halogen})-$ ,  $-\text{C}(\text{alkyl})(\text{halogen})-$ ,  $-\text{CH}(\text{CN})-$ ,  $-\text{C}(\text{alkyl})(\text{CN})-$ , or  $-\text{C}(=\text{O})-$ ,  $-\text{CH}(\text{O-alkyl})-$ ,  $-\text{CH}_2\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{CH}_2$ ,  $-\text{CH}(\text{alkyl})\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{CH}(\text{alkyl})-$ ,  $-\text{CH}=\text{CH}-$ ,  $-\text{C}(\text{alkyl})=\text{CH}-$ ,  $-\text{CH}=\text{C}(\text{alkyl})-$ ,  $-\text{C}(\text{alkyl})=\text{C}(\text{alkyl})-$ ,  $-\text{C}(=\text{O})\text{CH}=\text{CH}-$ , arylene,  $-\text{Si}(\text{halogen})_2-$ ,  $-\text{Si}(\text{alkyl})_2$ ,  $-\text{CH}-\text{CH}-$ ,  $-\text{C}(\text{alkyl})-\text{CH}-$ ,  $-\text{CH}-\text{C}(\text{alkyl})-$  or

$-\text{C}(\text{alkyl})-\text{C}(\text{alkyl})-$ ;

wherein  $h$  is a value of from 0 to 2 inclusive;

$\text{Z}_{13}$  represents  $\text{O}$ ,  $\text{S}$ ,  $\text{C}_1-\text{C}_8$  alkylidene, substituted or unsubstituted benzylidene,  $\text{NH}$  or  $\text{NR}'''$  wherein  $\text{R}'''$  is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

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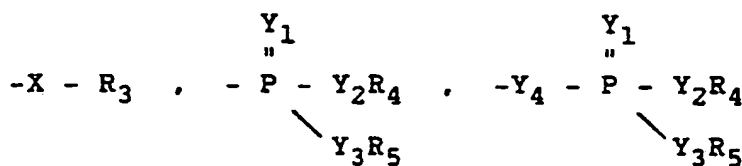
$Y_{83}$ ,  $Y_{84}$  and  $Y_{85}$  are the same or different and represent hydrogen, halogen, alkyl, hydroxy, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl, alkylamino, amino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy or polyhaloalkylsulfonyloxy; in which the permissible substituents for formulae (i) through (xxxi) above are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino,

polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,

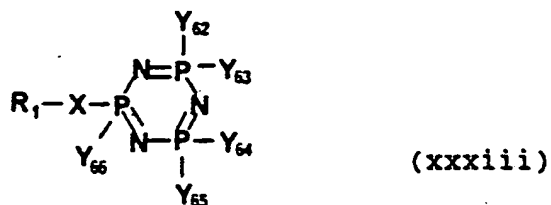
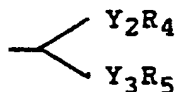
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aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>,



or



wherein:

Y<sub>62</sub>, Y<sub>63</sub>, Y<sub>64</sub>, Y<sub>65</sub> and Y<sub>66</sub> are  
 the same or different and are halogen;

R<sub>1</sub> is a substituted or unsubstituted,  
 carbocyclic or heterocyclic ring system selected  
 from a monocyclic aromatic or nonaromatic ring  
 system, a bicyclic aromatic or nonaromatic ring

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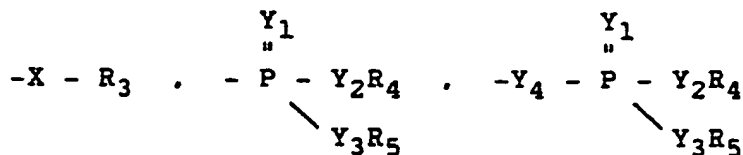
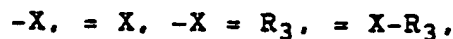
system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy,

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polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, or a hydroxy  
group condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyle, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroyleamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, aryleamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,



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or



$R_1$  is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryl dialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or

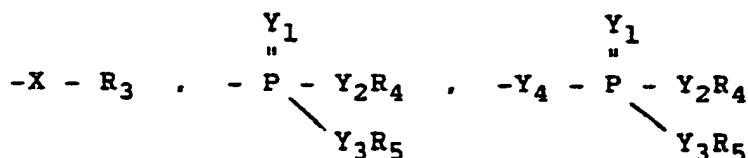
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polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyle, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,

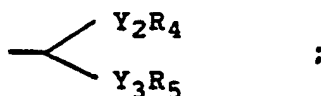
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aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



X is a covalent single bond or double bond,  
 a substituted or unsubstituted heteroatom or  
 substituted carbon atom, or a substituted or  
 unsubstituted, branched or straight chain containing  
 two or more carbon atoms or heteroatoms in any  
 combination in which the permissible substituents  
 are the same or different and are one or more  
 hydrogen, halogen, alkylcarbonyl,  
 alkylcarbonylalkyl, alkoxycarbonylalkyl,  
 alkoxycarbonylalkylthio, polyhaloalkenylthio,  
 thiocyno, propargylthio, hydroxyimino, alkoxyimino,

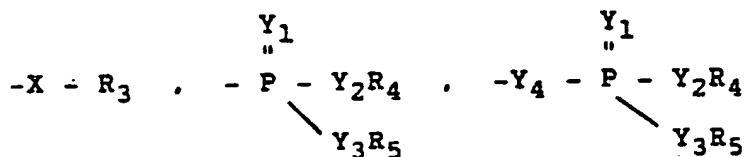
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trialkylsilyloxy, aryldialkylsilyloxy,  
triarylsilyloxy, formamidino, alkylsulfamido,  
dialkylsulfamido, alkoxysulfonyl,  
polyhaloalkoxysulfonyl, hydroxy, amino,  
aminocarbonyl, alkylaminocarbonyl,  
dialkylaminocarbonyl, aminothiocarbonyl,  
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
nitro, cyano, hydroxycarbonyl and derivative salts,  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,

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alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxylalkylphosphinyl,  
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxylphosphino, hydroxyamino, alkoxylamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,  
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or

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$R_{36}$  is a substituted or unsubstituted, asymmetrical heterocyclic ring system having at least three nitrogen atoms which are selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino,

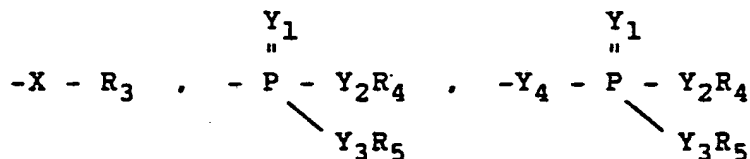
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alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxylalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxylalkoxy, carboxylalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,

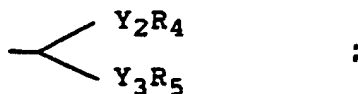
- 282 -

trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



wherein:

$R_3$  is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxyalkonylalkyl, alkoxyalkonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido,



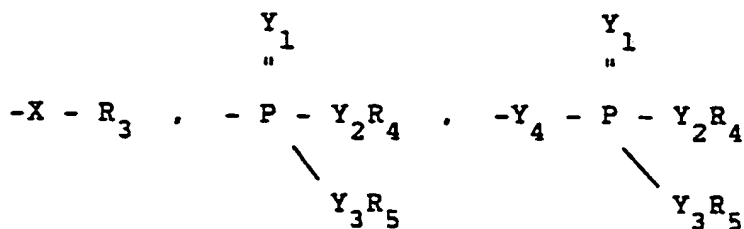
- 283 -

dialkylsulfamido, alkoxysulfonyl,  
polyhaloalkoxysulfonyl, hydroxy, amino,  
aminocarbonyl, alkylaminocarbonyl,  
dialkylaminocarbonyl, aminothiocarbonyl,  
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
nitro, cyano, hydroxycarbonyl and derivative salts,  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,

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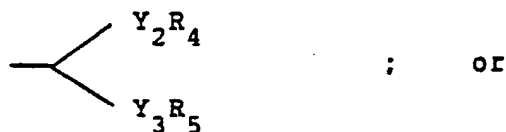
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyposphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium.

$-X, = X, -X = R_3, = X-R_3,$



or

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$R_3$  is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino,

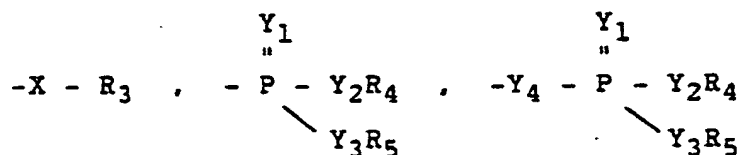
- 286 -

polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxylalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,

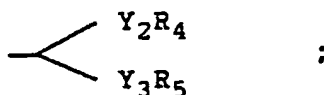
- 287 -

aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>,



or



Y<sub>1</sub> and Y<sub>4</sub> are independently oxygen or sulfur;

Y<sub>2</sub> and Y<sub>3</sub> are independently oxygen, sulfur, amino or a covalent bond; and

R<sub>4</sub> and R<sub>5</sub> are independently hydrogen or substituted or unsubstituted alkyl, polyhaloalkyl, phenyl or benzyl in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxyalkonylalkyl, alkoxyalkonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxyalkonyl, polyhaloalkoxyalkonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl,

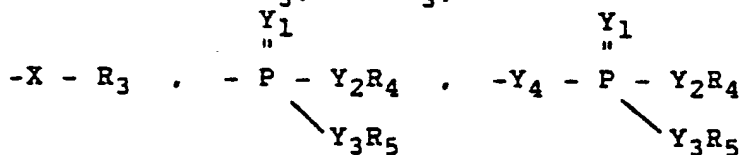
- 288 -

dialkylaminocarbonyl, aminothiocarbonyl,  
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
nitro, cyano, hydroxycarbonyl and derivative salts,  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,

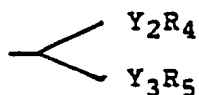
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aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxylalkylphosphinyl,  
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxylphosphino, hydroxyamino, alkoxylamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,  
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

-X. = X. -X = R<sub>3</sub>. = X-R<sub>3</sub>.



or

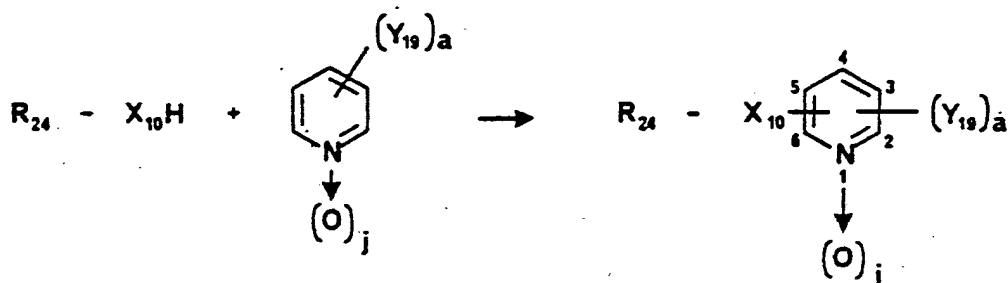


The heterocyclic nitrogen-containing  
 compounds encompassed within formula 1 can be  
 prepared by conventional methods known in the art,  
 and many may be available from various suppliers.

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The novel heterocyclic nitrogen-containing compounds of formulae (i) through (xxxiii) above which may be used in the method of this invention can be prepared by reacting appropriate starting ingredients in accordance with conventional procedures described in the art as illustrated below.

The novel heterocyclic nitrogen-containing compounds of formula (i) can be prepared by the following general reaction scheme:



Scheme I

wherein  $R_{24}$ ,  $X_{10}$ ,  $a$ ,  $j$  and  $Y_{19}$  are as defined hereinabove. Reactions of this general type for preparing substituted pyridines including process conditions are described for example by Mertel, H.E., The Chemistry of Heterocyclic Compounds, Pyridine and Derivatives-Part Two, Halopyridines, p. 351, Interscience, Wiley, New York (1961).

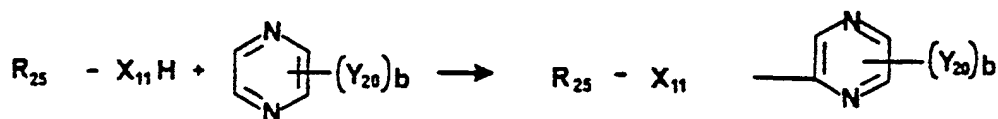
Intermediates such as 2,4,6-trichloropyridine are described in U.S. Patent 3,830,820. Other preparation methods for the novel compounds of formula (i) are described in Fuson, R.C., Advanced Organic Chemistry, p. 124, Wiley, New York (1950).



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and Ochiai, E., Aromatic Amine Oxides, p. 21.  
Elsevier, New York (1967).

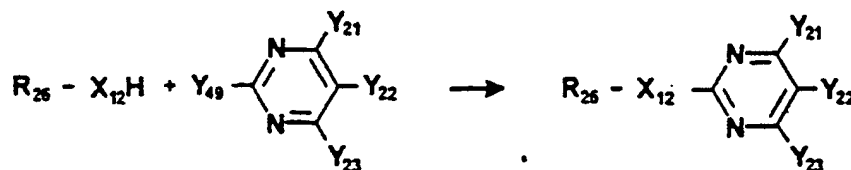
The novel heterocyclic nitrogen-containing  
compounds of formula (ii) can be prepared by the  
following general reaction scheme:



Scheme II

wherein  $R_{25}$ ,  $X_{11}$ ,  $b$  and  $Y_{20}$  are as defined  
hereinabove. Reactions of this general type for  
preparing substituted pyrazines including process  
conditions are described for example in U.S. Patent  
4,254,125.

The novel heterocyclic nitrogen-containing  
compounds of formula (iii) can be prepared by the  
following general reaction scheme:

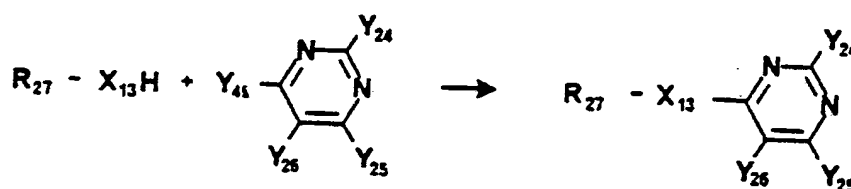


Scheme III

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wherein  $R_{26}$ ,  $X_{12}$ ,  $Y_{21}$ ,  $Y_{22}$  and  $Y_{23}$  are as defined hereinabove and  $Y_{49}$  is halogen. Reactions of this general type for preparing 2-substituted pyrimidines including process conditions are described for example by Hurst, D.T., An Introduction to the Chemistry and Biochemistry of Pyrimidines, Purines and Pteridines, pp. 49-53, Wiley, New York (1980). Intermediates in which  $Y_{21}$  and  $Y_{23}$  are alkylthio are described by Eilingsfeld, H. and Schevermann, H., Chem. Ber., 100, pp. 1874-1891 (1967). Other preparation methods for the novel compounds of formula (iii) such as the Rembry-Hull pyrimidine synthesis are described in Brown, D.J., The Pyrimidines; The Chemistry of Heterocyclic Compounds, pp. 98, 169-170, 166, Interscience, Wiley, New York (1960).

The novel heterocyclic nitrogen-containing compounds of formula (iv) can be prepared by the following general reaction scheme:

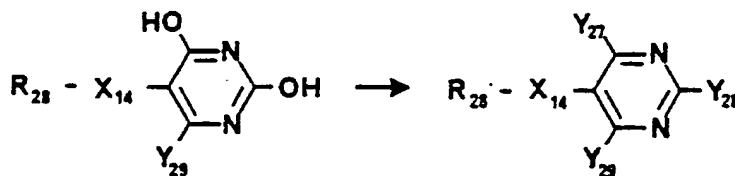


Scheme IV

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wherein  $R_{27}$ ,  $X_{13}$ ,  $Y_{24}$ ,  $Y_{25}$ ,  $Y_{26}$  and  $Y_{49}$  are as defined hereinabove. Reactions of this general type for preparing 4-substituted pyrimidines including process conditions are described for example by Josima, T., et. al. Sankyo Kenkyusho Newpo, 32, pp. 114-120 (1980).

The novel heterocyclic nitrogen-containing compounds of formula (v) can be prepared by the following general reaction scheme:

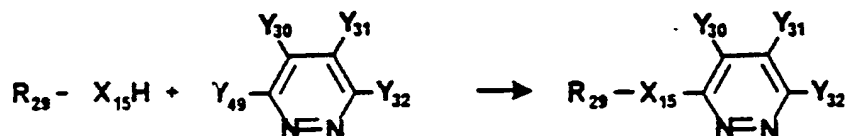


Scheme V

wherein  $R_{28}$ ,  $X_{14}$ ,  $Y_{27}$ ,  $Y_{28}$  and  $Y_{29}$  are as defined hereinabove. Reactions of this general type for preparing 5-substituted pyrimidines including process conditions and intermediate preparations are described for example by Fieser, L.F. and Fieser, M., Organic Chemistry, p. 310, Heath, Boston (1972) also Brown, D.J., The Pyrimidines; The Chemistry of Heterocyclic Compounds, pp. 50, 166, Interscience, Wiley, New York (1962).

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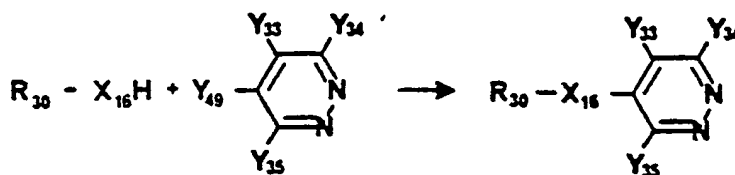
The novel heterocyclic nitrogen-containing compounds of formula (vi) can be prepared by the following general reaction scheme:



Scheme VI

wherein  $R_{29}$ ,  $X_{15}$ ,  $Y_{30}$ ,  $Y_{31}$ ,  $Y_{32}$  and  $Y_{49}$  are as defined hereinabove. Reactions of this general type for preparing 3-substituted pyridazines including process conditions and intermediate preparations are described for example by Jojima, T. et al., Agric. Biol. Chem., 32, (11), 1376-1381 (1968) and Eilingsfeld, H. and Schevermann, H., Chem. Ber., 100, 1874-1891 (1967).

The novel heterocyclic nitrogen-containing compounds of formula (vii) can be prepared by the following general reaction scheme:

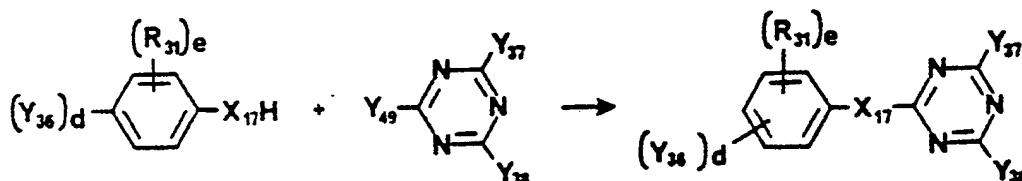


Scheme VII

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wherein  $R_{30}$ ,  $X_{16}$ ,  $Y_{33}$ ,  $Y_{34}$ ,  $Y_{35}$  and  $Y_{49}$  are as defined hereinabove. Reactions of this general type for preparing 4-substituted pyridazines including process conditions and intermediate preparations are described for example by Jojime, T. et al., Agric. Biol. Chem., 32, (11), 1376-1381 (1968).

The novel heterocyclic nitrogen-containing compounds of formula (viii) can be prepared by the following general reaction scheme:



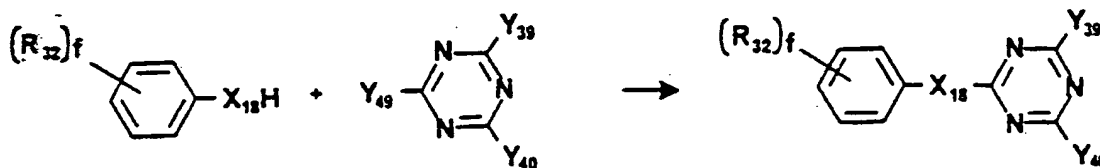
Scheme VIII

wherein  $Y_{36}$ ,  $Y_{37}$ ,  $Y_{38}$ ,  $Y_{49}$ ,  $d$ ,  $e$ ,  $R_{31}$  and  $X_{17}$  are as defined hereinabove. Reactions of this general type for preparing substituted 1,3,5-triazines including process conditions and intermediate preparations are described for example in German Patent 952,478, U.S. Patent 2,824,823, Koopman, H. et al., Rec. Trav. Chim., 78, 967-980 (1959), Drabek, J. and Skrobal, M., Chem. Zvesti,

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17, (7), 482-487 (1963), Hirt, R. et al., Helv. Chim. Acta, 33, 1365 (1950), and German Patent 1,076,696. Other preparation methods for the novel compounds of formula (viii) are described in U.S. Patent 4,220,765, U.S. Patent 2,691,019 and Chakrabarti, J.K. et al., J. Chem. Soc. 861 (1974).

The novel heterocyclic nitrogen-containing compounds of formula (ix) can be prepared by the following general reaction scheme:



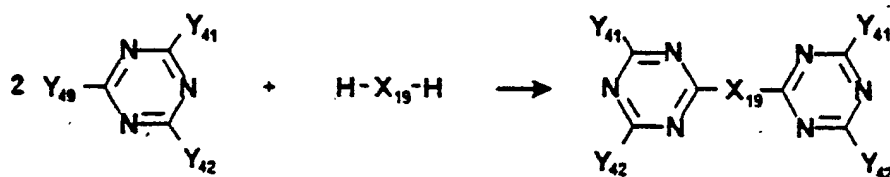
Scheme IX

wherein  $R_{32}$ ,  $f$ ,  $X_{18}$ ,  $Y_{39}$ ,  $Y_{40}$  and  $Y_{49}$  are as defined hereinabove. Reactions of this general type for preparing substituted 1,3,5-triazines including process conditions and intermediate preparations are described for example in U.S.

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Patent 3,316,264. Intermediates such as 2,4-dichloro-6-(diethoxyphosphinyl)-1,3,5-triazine are described in Japan Patent 74 46635. Other preparation methods for the novel compounds of formula (ix) are described in Mendoza, C.E. et al., J. Ag. Food Chem., 19, (1), 41-45 (1972).

The novel heterocyclic nitrogen-containing compounds of formula (x) can be prepared by the following general reaction scheme:

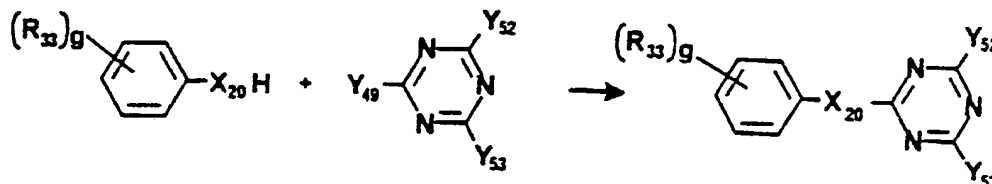


Scheme X

wherein Y<sub>41</sub>, Y<sub>42</sub>, Y<sub>49</sub> and X<sub>19</sub> are as defined hereinabove. Reactions of this general type for preparing bis-1,3,5-triazines including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (viii) above.

The novel heterocyclic nitrogen-containing compounds of formula (xi) can be prepared by the following general reaction scheme:

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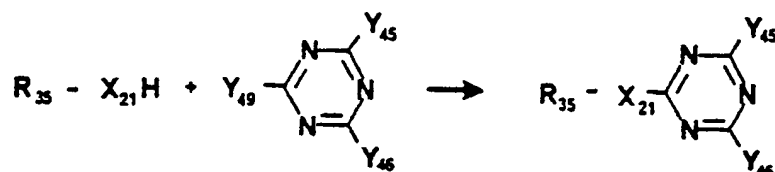
Scheme XI

wherein  $R_{33}$ ,  $g$ ,  $X_{20}$ ,  $Y_{52}$ ,  $Y_{53}$  and  $Y_{49}$  are as defined hereinabove. Reactions of this general type for preparing substituted 1,3,5-triazines including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (viii) above. Other preparation methods for the novel compounds of formula (xi) are described in Allen, C.F.H. and Converse, S., Org. Syn. Coll., Vol. I, 226-227, U.S. Patent 1,911,689, Bessiere-Chretien, Y. and Serne, H., Bull. Soc. Chim. France, (6), Part 2, 2039-2046 (1973), Japan Patent 28,101, Japan Patent 28,100, Japan Patent 28,098, Japan Patent 9155, Loew, P. and Weis, C.D., J. Heterocyclic Chem., 13, 829-833 (1976) and Richter, G.H., Textbook of Organic Chemistry, p. 486, Wiley, New York (1967).

The novel heterocyclic nitrogen-containing compounds of formula (xii) can be prepared by the following general reaction scheme:



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Scheme XII

wherein  $R_{35}$ ,  $X_{21}$ ,  $Y_{45}$ ,  $Y_{46}$  and  $Y_{49}$  are as defined hereinabove. Reactions of this general type for preparing heterocyclic substituted 1,3,5-triazines including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (viii) above. Other preparation methods for the novel compounds of formula (xii) are described in Koopman, H. and Daams, J., Rec. Trav. Chim., 77, 235-240 (1958) and United Kingdom Patent 908,352.

The novel heterocyclic nitrogen-containing compounds of formula (xiii) can be prepared by the following general reaction scheme:

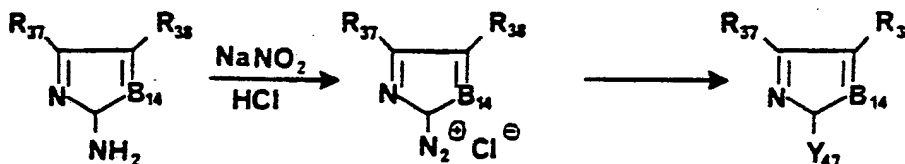


Scheme XIII

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wherein  $R_{37}$ ,  $R_{38}$ ,  $B_{14}$  and  $Y_{47}$  are as defined hereinabove. Reactions of this general type for preparing substituted azoles including process conditions and intermediate preparations are described for example by Hautzsch, A., Chem. Ber., 24, 495 (1891), Adembri, G. and Tedeschi, P., Bull. Sci. Facul. Chim. Ind. Bologna, 23, 203 (1965) and Carr, J.B. et al., J. Med. Chem., 20, (7), 934-939 (1977).

The novel heterocyclic nitrogen-containing compounds of formula (xiv) can be prepared by the following general reaction scheme:



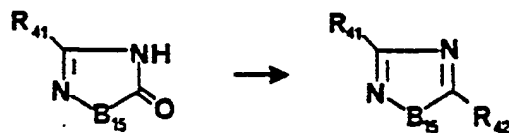
Scheme XIV

wherein  $R_{37}$ ,  $R_{38}$ ,  $B_{14}$  and  $Y_{47}$  are as defined hereinabove. Reactions of this general type for preparing substituted azoles including process conditions and intermediate preparations are described in Pahanayak, B.K., J. Ind. Chem. Soc., 55, (3), 264-267 (1978) and Young, T.E. and Amstutz, E.D., J. Amer. Chem. Soc., 73, 4773-4775, (1951). Other preparation methods for the novel compounds of formula (xiv) are described by Tripathi, H. et al.,

- 301 -

Agric. Biol. Chem., 37, 1375 (1973) and Young, T.E. and Amstutz, E.D., J. Amer. Chem. Soc. 73, 4773-4775 (1951).

The novel heterocyclic nitrogen-containing compounds of formula (xv) can be prepared by the following general reaction scheme:

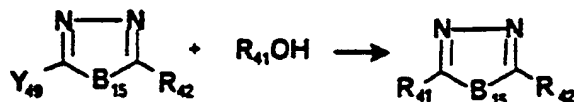


Scheme XV

wherein R<sub>41</sub>, R<sub>42</sub>, and B<sub>15</sub> are as defined hereinabove. Reactions of this general type for preparing substituted 1,2,4-azoles including process conditions and intermediate preparations are described by Selim, M. and Selim, M., Bull. Soc. Chim. France, 1219-1220 (1967).

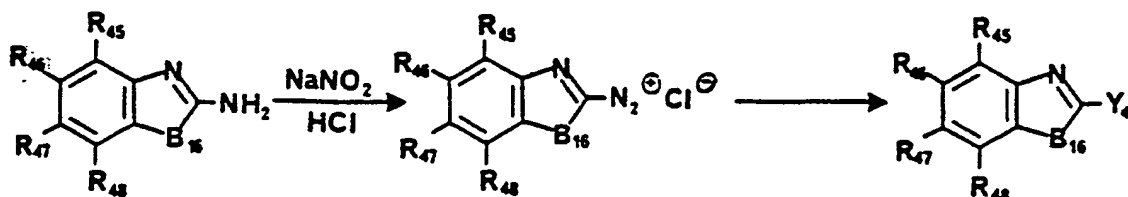
The novel heterocyclic nitrogen-containing compounds of formula (xvi) can be prepared by the following general reaction scheme:

- 302 -

Scheme XVI

wherein  $\text{R}_{41}$ ,  $\text{R}_{42}$ ,  $\text{B}_{15}$  and  $\text{Y}_{49}$  are defined hereinabove. Reactions of this general type for preparing substituted 1,3,4-azoles including process conditions and intermediate preparations are described by Koopman, H. et al., Rec. Trav. Chim, 78, 967-980 (1959). A useful intermediate is described in United Kingdom Patent 913,910.

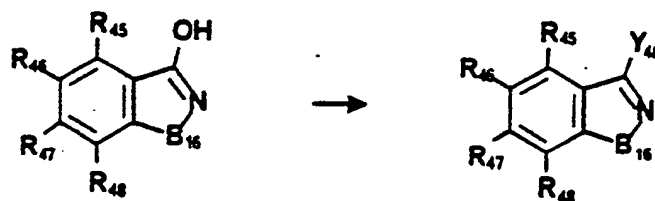
The novel heterocyclic nitrogen-containing compounds of formula (xvii) can be prepared by the following general reaction scheme:

Scheme XVII

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wherein  $R_{45}$ ,  $R_{46}$ ,  $R_{47}$ ,  $R_{48}$ ,  $B_{16}$  and  $Y_{48}$  are as defined hereinabove. Reactions of this general type for preparing substituted benzazoles including process conditions and intermediate preparations are described by Hegershoff, A., Chem. Ber., 36, 3121-3134 (1903) and Young, T.E. and Amstutz, E.D., J. Amer. Chem. Soc., 73, 4773-4775 (1951).

The novel heterocyclic nitrogen-containing compounds of formula (xviii) can be prepared by the following general reaction scheme:

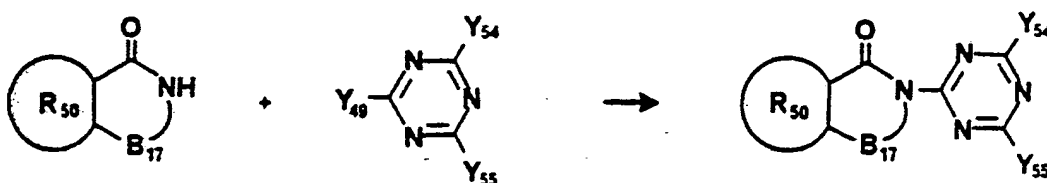


Scheme XVIII

wherein  $R_{45}$ ,  $R_{46}$ ,  $R_{47}$ ,  $R_{48}$ ,  $B_{16}$  and  $Y_{48}$  are as defined hereinabove. Reactions of this general type for preparing substituted benzisoxazoles including process conditions and intermediate preparations are described in Comprehensive Heterocyclic Chemistry, Vol. 16, p. 58, Pergamon Press, New York (1984).

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The novel heterocyclic nitrogen-containing compounds of formula (xix) can be prepared by the following general reaction scheme:

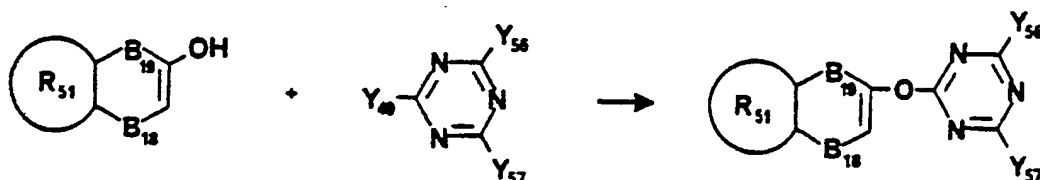


Scheme XIX

wherein R<sub>50</sub>, B<sub>17</sub>, Y<sub>54</sub>, Y<sub>55</sub> and Y<sub>49</sub> are as defined hereinabove. Reactions of this general type for preparing substituted 1,3,5-triazines including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (viii) above. Other preparation methods for the novel compounds of formula (xix) are described by Beech, W.F., J. Chem. Soc., (C), 466-472 (1967).

The novel heterocyclic nitrogen-containing compounds of formula (xx) can be prepared by the following general reaction scheme:

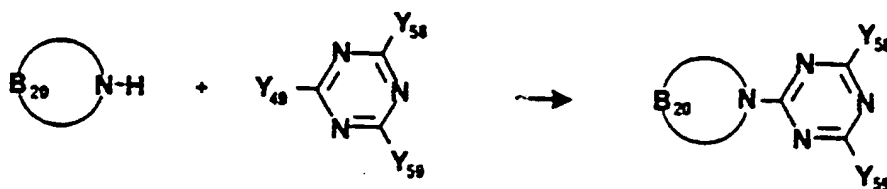
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Scheme XX

wherein R<sub>51</sub>, B<sub>18</sub>, B<sub>19</sub>, Y<sub>56</sub>, Y<sub>57</sub> and Y<sub>49</sub> are as defined hereinabove. Reactions of this general type for preparing substituted 1,3,5-triazines including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (viii) above.

The novel heterocyclic nitrogen-containing compounds of formula (xxi) can be prepared by the following general reaction scheme:

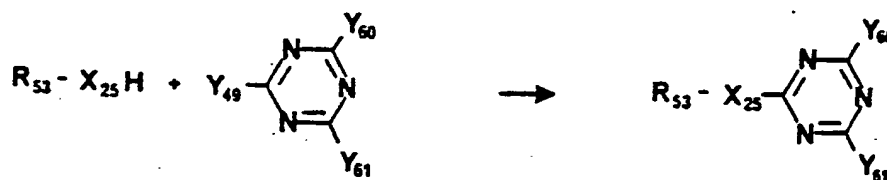


Scheme XXI

- 306 -

wherein  $B_{20}$ ,  $Y_{58}$ ,  $Y_{59}$  and  $Y_{49}$  are as defined hereinabove. Reactions of this general type for preparing substituted 1,3,5-triazines including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (viii) above.

The novel heterocyclic nitrogen-containing compounds of formula (xxii) can be prepared by the following general reaction scheme:



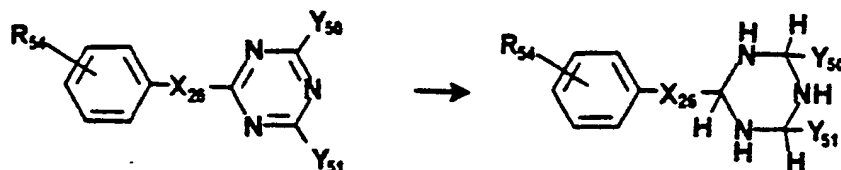
Scheme XXII

wherein  $R_{53}$ ,  $X_{25}$ ,  $Y_{60}$ ,  $Y_{61}$  and  $Y_{49}$  are as defined hereinabove. Reactions of this general type for preparing substituted 1,3,5-triazines including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (viii) above.

The novel heterocyclic nitrogen-containing compounds of formula (xxiii) can be prepared by the following general reaction scheme:

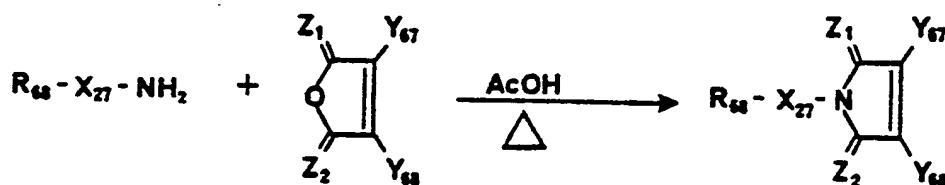


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Scheme XXIII

wherein  $R_{54}$ ,  $X_{26}$ ,  $Y_{50}$  and  $Y_{51}$  are as defined hereinabove. Reactions of this general type for preparing hexahydro-1,3,5-triazines including process conditions are described for example by Meyers, A.I. et al., J. Amer. Chem. Soc., 91, 763 (1969). The preparation of appropriate intermediates is similar to procedures employed for preparing compounds of formula (viii) above.

The novel heterocyclic nitrogen-containing compounds of formula (xxiv) can be prepared by the following general reaction scheme:

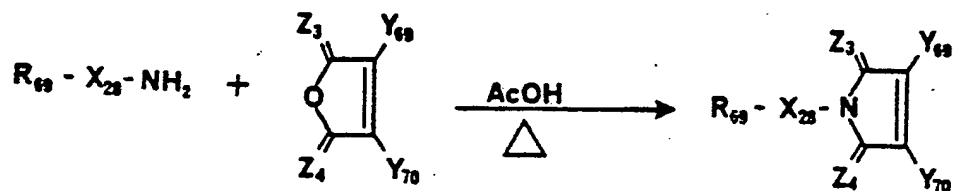
Scheme XXIV

wherein  $R_{68}$ ,  $X_{27}$ ,  $Z_1$ ,  $Z_2$ ,  $Y_{67}$  and  $Y_{68}$  are as defined hereinabove. Reactions of this general type for preparing substituted maleimides including process conditions and intermediate preparations are described for example in Japan

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Patent 75,117,929. Other preparation methods for the novel compounds of formula (xxiv) are described in U.S. Patent 3,129,225 and Japan Patent 75,132,129.

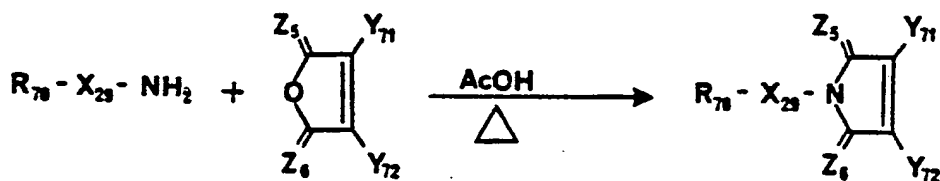
The novel heterocyclic nitrogen-containing compounds of formula (xxv) can be prepared by the following general reaction scheme:



Scheme XXV

wherein  $R_{69}$ ,  $X_{28}$ ,  $Z_3$ ,  $Z_4$ ,  $Y_{69}$  and  $Y_{70}$  are as defined hereinabove. Reactions of this general type for preparing substituted maleimides, including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (xxiv) above.

The novel heterocyclic nitrogen-containing compounds of formula (xxvi) can be prepared by the following general reaction scheme:

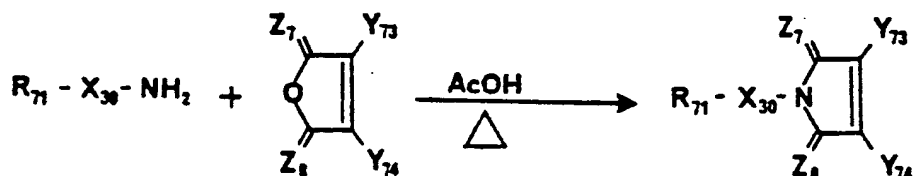


Scheme XXVI

wherein  $R_{70}$ ,  $X_{29}$ ,  $Z_5$ ,  $Z_6$ ,  $Y_{71}$  and  $Y_{72}$  are as defined hereinabove. Reactions of this general type for preparing substituted maleimides including process conditions and intermediate

preparations are similar to the procedures employed for preparing compounds of formula (xxiv) above.

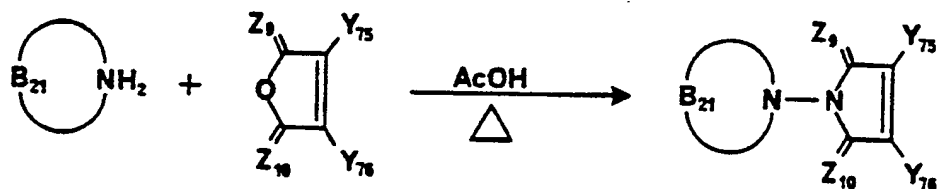
The novel heterocyclic nitrogen-containing compounds of formula (xxvii) can be prepared by the following general reaction scheme:



Scheme XXVII

wherein  $R_{71}$ ,  $X_{30}$ ,  $Z_7$ ,  $Z_8$ ,  $Y_{73}$  and  $Y_{74}$  are as defined hereinabove. Reactions of this general type for preparing substituted maleimides including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (xxiv) above.

The novel heterocyclic nitrogen-containing compounds of formula (xxviii) can be prepared by the following general reaction scheme:



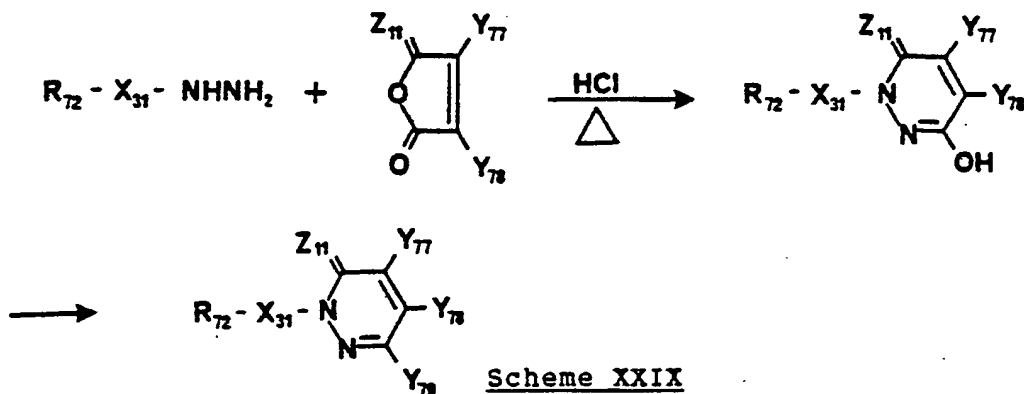
Scheme XXVIII

wherein  $B_{21}$ ,  $Z_9$ ,  $Z_{10}$ ,  $Y_{75}$  and  $Y_{76}$  are as defined hereinabove. Reactions of this general type for preparing substituted maleimides including process conditions and intermediate preparations are

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similar to the procedures employed for preparing compounds of formula (xxiv) above.

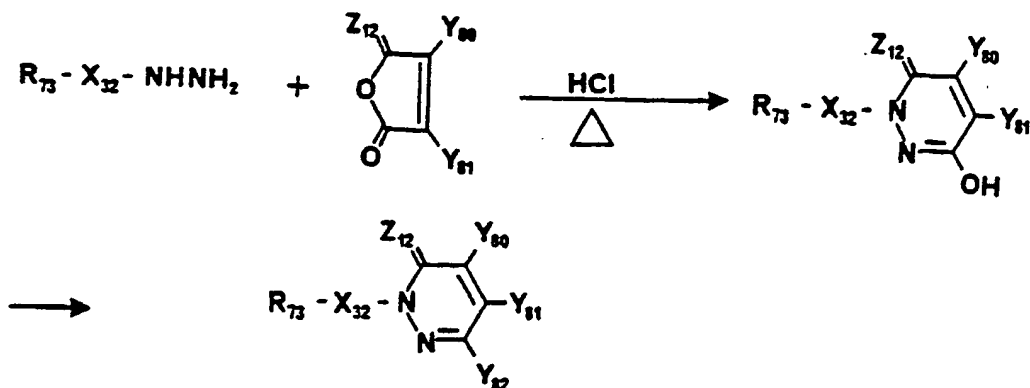
The novel heterocyclic nitrogen-containing compounds of formula (xxix) can be prepared by the following general reaction scheme:



wherein  $R_{72}$ ,  $Y_{31}$ ,  $Z_{11}$ ,  $Y_{77}$ ,  $Y_{78}$  and  $Y_{79}$  are as defined hereinabove. Suitable halogenating agents include, for example,  $PCl_5$ ,  $POCl_3$ ,  $PBr_5$  and  $POBr_3$  and mixtures thereof. Reactions of this general type for preparing substituted pyridazinones including process conditions and intermediate preparations are described for example in Yuki Gosei Kagaku Kyotai Shi 28, (4), 462-463 (1970). Other preparation methods for the novel compounds of formula (xxix) are described in Yakugaku Zasshi 86, (12), 1168-1172 (1966), Acta Dol. Pharm. 36, (3), 301-306 (1979), U.S. Patent 2,963,477, Japan Patent 6,822,309, Org. Prep. Proced. Int. 17, (2), 107-114 (1985), Arm. Khim. Zh. 21, (6), 515-520 (1968) and German Patent 1,948,550.

The novel heterocyclic nitrogen-containing compounds of formula (xxx) can be prepared by the following general reaction scheme:

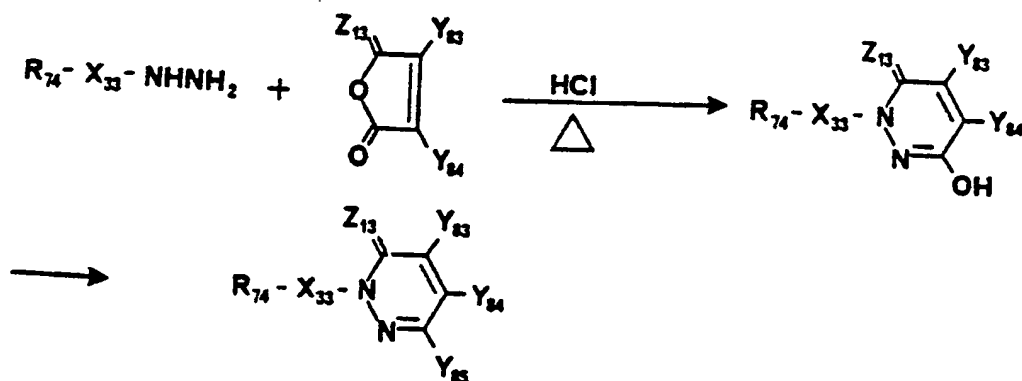
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Scheme XXX

wherein  $R_{73}$ ,  $X_{32}$ ,  $Z_{12}$ ,  $Y_{80}$ ,  $Y_{81}$  and  $Y_{82}$  are as defined hereinabove. Reactions of this general type for preparing substituted pyridazinones including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (xxix) above.

The novel heterocyclic nitrogen-containing compounds of formula (xxxii) can be prepared by the following general reaction scheme:



Scheme XXXI

wherein  $R_{74}$ ,  $X_{33}$ ,  $Z_{13}$ ,  $Y_{83}$ ,  $Y_{84}$  and  $Y_{85}$  are as defined hereinabove. Reactions of this general type for preparing substituted pyridazinones

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including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (xxix) above.

The novel heterocyclic nitrogen-containing compounds of formula (xxxii) can be prepared by the following general reaction scheme:

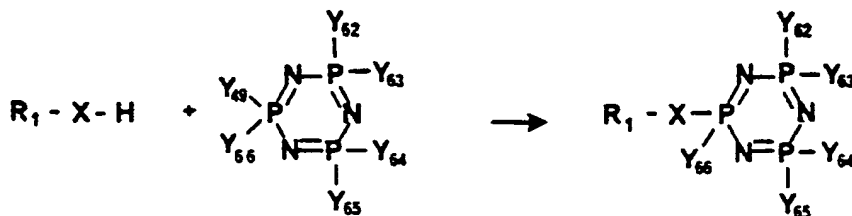


Scheme XXXII

wherein  $R_1$ , X,  $R_{36}$  and  $Y_{49}$  are as defined hereinabove. Reactions of this general type for preparing substituted asymmetrical compounds including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (viii) above using appropriate starting ingredients.

The novel heterocyclic nitrogen-containing compounds of formula (xxxiii) can be prepared by the following general reaction scheme:

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Scheme XXXIII

wherein  $R_1$ ,  $Y_{62}$ ,  $Y_{63}$ ,  $Y_{64}$ ,  $Y_{65}$ ,  $Y_{66}$  and  $X$  are as defined hereinabove. Reactions of this general type for preparing substituted cyclotriphosphazenes including process conditions and intermediate preparations are similar to the procedures employed for preparing compounds of formula (viii) above using appropriate starting ingredients.

In addition to the above, other illustrative procedures which may be employed in preparing heterocyclic nitrogen-containing compounds encompassed within formula 1 are described, for example, in the following: Italy Patent 589,543, Italy Patent 588,280, United Kingdom Patent 872,313, Canada Patent 659,610, PCT Application AU81/00046, U.S. Patent 3,203,550, U.S. Patent, 3,931,165, U.S. Patent, 2,720,480, U.S. Patent 4,038,197, U.S. Patent 3,682,903, U.S. Patent 3,775,406, U.S. Patent 3,932,167, U.S. Patent 4,390,538, U.S. Patent 3,361,746, U.S. Patent 4,414,221, U.S. Patent 4,237,127, U.S. Patent 3,951,971 and U.S. Patent 3,973,947.

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The antitranspirant compounds of formula 1 have been found to significantly reduce plant and crop usage of water, i.e., reduce transpiration rate, and increase the resistance of plant leaf surfaces to the loss of moisture vapor, i.e., increase diffusive resistance. In addition, the antitranspirant compounds used in this invention are substantially non-inhibiting of photosynthetic light-requiring reactions, substantially non-phytotoxic to growing plants and serve to increase crop yields in comparison with untreated crops at similar conditions, especially in regions where plants are subject to moisture stress conditions. The antitranspirant compounds used in this invention provide for the conservation of soil moisture by reducing plant and crop usage of water during certain development periods, e.g., vegetative period, thereby making the unused water available at other periods of plant or crop development, e.g., reproductive growth period.

As indicated above, stomata are minute openings in the epidermis of plant leaf surfaces through which occurs gaseous interchange between the atmosphere and the intercellular spaces within the leaf. It is believed that the antitranspirant compounds of formula 1 effectively reduce the transpiration rate in plants by closing plant stomata or constricting plant stomatal openings to such a degree that moisture loss is reduced and, in addition, the compounds exhibit substantially no detrimental effect on photosynthetic electron flow.



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The photosynthetic process in plants consists of light-requiring reactions, i.e., light reactions, and non-light-requiring reactions, i.e., dark reactions. The dark reactions in general involve a complex of enzyme-mediated reactions which provide for the conversion of carbon dioxide to sugar. In addition to carbon dioxide, the dark reactions require reducing power and chemical energy which are produced and provided by the light reactions. In general, two light-requiring reactions are involved in plant photosynthesis and are conventionally termed Photosystem I and Photosystem II. See, for example, Salisbury, F.B. and Ross, C.W., Plant Physiology, pp. 131-135 (1978). These photosystems are interconnected by an electron transport chain, and provide reducing power and chemical energy to the dark reactions. Inhibition of either or both of these photosystems can detrimentally affect photosynthesis, thereby causing plant injury or even plant death.

The antitranspirant compounds used in this invention have been found to cause no or substantially no inhibition of Photosystem I or Photosystem II. In contrast, the herbicide atrazine is known to substantially inhibit the light reactions of photosynthesis, particularly the electron transport chain. See, for example, Jachetta, J.J. and Radosevich, S.R., Weed Science 29: 37-43 (1981). Such herbicidal inhibition leads to a buildup of carbon dioxide within the leaf which causes closure of the stomates. See, for example, Smith, D. and Buchholtz, K.P., Plant Physiology 39:

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572-578 (1964). Thus, unlike the antitranspirant activity of the compounds used in this invention, the antitranspirant activity of atrazine is associated with its herbicidal properties. As used herein, substantially no inhibition of photosynthetic electron transport refers to no or little inhibition of photosynthetic electron transport.

As used herein, an effective amount of a heterocyclic nitrogen-containing compound for reducing moisture loss from plants refers to an antitranspirationally effective amount of the compound sufficient to reduce transpirational moisture loss from plants without substantially inhibiting plant photosynthetic electron transport. Likewise, an effective amount of a heterocyclic nitrogen-containing compound for increasing crop yield refers to a yield enhancing effective amount of the compound sufficient to increase crop yield without substantially inhibiting plant photosynthetic electron transport. In both instances, the effective amount of compound can vary over a wide range depending on the particular compound employed, the particular crop to be treated, environmental and climatic conditions, and the like, provided that the amount of compound used does not cause substantial inhibition of plant photosynthetic electron transport or substantial phytotoxicity, e.g., foliar burn, chlorosis or necrosis, to the plant. In general, the compound can preferably be applied to plants and crops at a concentration of from about

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0.25 to 15 pounds of compound per acre as more fully described below.

The heterocyclic nitrogen-containing compounds contemplated by formula 1 may be employed according to a variety of conventional methods known to those skilled in the art. Compositions containing the compounds as the active ingredient will usually comprise a carrier and/or diluent, either liquid or solid.

Suitable liquid diluents or carriers include water, petroleum distillates, or other liquid carriers with or without surface active agents. Liquid concentrates may be prepared by dissolving one of these compounds with a nonphytotoxic solvent such as acetone, xylene, nitrobenzene, cyclohexanone or dimethylformamide and dispersing the active ingredients in water with the aid of suitable surface active emulsifying and dispersing agents.

The choice of dispersing and emulsifying agents and the amount employed are dictated by the nature of the composition and the ability of the agent to facilitate the dispersion of the active ingredient. Generally, it is desirable to use as little of the agent as is possible, consistent with the desired dispersion of the active ingredient in the spray so that rain does not re-emulsify the active ingredient after it is applied to the plant and wash it off the plant. Nonionic, anionic, or cationic dispersing and emulsifying agents may be employed, for example, the condensation products of alkylene oxides with phenol and organic acids, alkyl

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aryl sulfonates, complex ether alcohols, quaternary ammonium compounds, and the like.

In the preparation of wettable powder or dust compositions, the active ingredient is dispersed in and on an appropriately divided solid carrier such as clay, talc, bentonite, diatomaceous earth, fuller's earth, and the like. In the formulation of the wettable powders, the aforementioned dispersing agents as well as lignosulfonates can be included.

The required amount of the active ingredient contemplated herein may be applied per acre treated in from 1 to 200 gallons or more of liquid carrier and/or diluent or in from about 5 to 500 pounds of inert solid carrier and/or diluent. The concentration in the liquid concentrate will usually vary from about 5 to 95 percent by weight and in the solid formulations from about 0.5 to about 90 percent by weight. Satisfactory sprays or dusts for general use contain from about 0.1 to about 100 pounds of active ingredient per acre, preferably from about 0.25 to about 15 pounds of active ingredient per acre, and more preferably from about 0.5 to about 5 pounds of active ingredient per acre.

Formulations useful in the conduct of this invention can also contain other optional ingredients such as stabilizers or other biologically active compounds, insofar as they do not impair or reduce the activity of the active ingredient and do not harm the plant being treated. Other biologically active compounds include, for

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example, one or more insecticidal, herbicidal, fungicidal, nematocidal, miticidal, plant growth regulators or other known compounds. Such combinations may be used for the known or other purpose of each ingredient and may provide a synergistic effect.

The antitranspirant compounds of formula 1 are preferably applied to plants and crops under substantially little or no water stress conditions, or what can be considered as average or normal growing conditions. A preferred condition for compound application is prior to substantial soil moisture loss. While not wishing to be bound to any particular theory, it is believed that application of the antitranspirant compounds does not result in a reduction of the minimum total water requirements of a treated plant or crop, but rather the application of such compounds serves to promote more efficient water utilization by treated plants and crops. It is believed that the antitranspirant effect does not reduce the total amount of water needed to grow a given plant or crop except for water savings which may be realized for some crops under irrigation, but rather such antitranspirant effect is manifested by an increase in yield of treated crops having no or limited irrigation and rainfall in comparison with untreated crops at similar conditions. Additionally, the antitranspirant compounds of formula 1 are preferably applied to plants and crops under conditions which favor large gradients in water vapor pressure between the saturated atmosphere

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within the leaf and the atmosphere around the leaf. Such conditions include low atmospheric humidity, high light/heat loads on the leaf, and high rates of air movement.

In particular, it is believed that the application of the antitranspirant compounds of formula 1 to plants, for example, during the vegetative growth phase reduces the amount of water utilized by the plant for on the order of about a 1 to 6 week period and therefore provides for a greater amount of reserve water available in the soil during other developmental periods such as the critical reproductive growth phase. This soil moisture conservation can minimize any water deficit within plant tissues during critical developmental periods such as the reproductive growth phase resulting in increased crop yield. The antitranspirant compounds used in this invention may likewise be applied during the plant reproductive growth phase to obtain similar results.

In general, the antitranspirant compounds of formula 1 are useful for decreasing irrigation water requirements especially in dry climate regions, for protecting plants from wilting or other damage during transplantation or shipment or during severe cold weather, and for alleviating water stress in certain types of environments as indicated above.

Such compounds are useful in agriculture, horticulture and related fields and can be applied to vegetation such as non-deciduous ornamental shrubs, evergreens, trees, and the like, to protect

them against winter kill. A chief cause of winter kill is an excessive loss of moisture from leaf surfaces on sunny or windy days when the ground is frozen and the root systems cannot replace the water loss. The antitranspirant compounds can also be applied to other ornamentals such as roses and other flowers, Christmas trees, and the like, to preserve freshness and retard needle drop. The antitranspirant compounds can further be used in avoiding or minimizing the effects of summer scald and transplant shock.

In addition to the above, it is recognized that the antitranspirant compounds of formula 1 may also be used to control foliar diseases on crops such as wheat and oats. See, for example, Avant Gardener, Vol. 18, No. 1, November, 1985, in which antitranspirants are used to control fungus diseases.

As used herein, plants refer in general to any agronomic or horticultural crops, ornamentals and turfgrasses. Illustrative of plants which may be treated by the antitranspirant compounds of formula 1 according to the method of this invention include, for example, corn, cotton, sweet potatoes, white potatoes, alfalfa, wheat, rye, upland rice, barley, oats, sorghum, dry beans, soybeans, sugar beets, sunflowers, tobacco, tomatoes, canola, deciduous fruit, citrus fruit, tea, coffee, olives, pineapple, cocoa, banana, sugar cane, oil palm, herbaceous bedding plants, woody shrubs, turfgrasses, ornamental plants, evergreens, trees, flowers, and the like. As used herein, crops refer in general to any of the illustrative agronomic or

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horticultural crops above. Transplanted stock as used herein refers in general to tobacco, tomatoes, eggplant, cucumbers, lettuce, strawberries, herbaceous bedding plants, woody shrubs, tree seedlings and the like.

The antitranspirant compounds contemplated herein reduce transpirational moisture loss from plants and increase crop yields. Such compounds have a high margin of safety in that when used in sufficient amount to provide an antitranspirant effect or yield enhancing effect, they do not inhibit plant photosynthetic electron transport or burn or injure the plant, and they resist weathering which includes wash-off caused by rain, decomposition by ultraviolet light, oxidation, or hydrolysis in the presence of moisture or, at least, such decomposition, oxidation, and hydrolysis as would materially decrease the desirable antitranspirant characteristic of the active ingredient or impart undesirable characteristics, for instance, phytotoxicity, to the active ingredients. Mixtures of the active compounds may be employed if desired as well as combinations of the active compounds with other biologically active compounds or ingredients as indicated above.

This invention is illustrated by the following examples:



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Example IPreparation of 2,4-dichloro-6-(4-methylphenylthio)-  
1,3,5-triazine

Into a solution containing 18.4 grams (0.1 mole) of cyanuric chloride in 200 milliliters of acetone was added, with cooling at a temperature of 0-5°C and magnetic stirring, a solution containing 12.4 grams (0.1 mole) of 4-methylthiophenol and 10.7 grams (0.1 mole) of 2,6-lutidine in 50 milliliters of acetone. The solution was added at such a rate to maintain the reaction temperature at 0-5°C. The resulting mixture was magnetically stirred for a period of 2 hours, allowed to warm to room temperature, and precipitated 2,6-lutidine hydrochloride was filtered off and washed with acetone. The combined filtrates were then poured onto ice and the resulting precipitated solid was collected by filtration. The solid was washed with 100 milliliters of 10% aqueous NaOH and then 100 milliliters of water. After drying, the solid was recrystallized twice from hexane to give a crude yield of 5 grams. This material was further purified by vacuum sublimation to give 1.16 grams (0.004 mole) of pure 2,4-dichloro-6-(4-methylphenylthio)-1,3,5-triazine having a melting point of 112°C-114°C. Elemental analysis of the product indicated the following:

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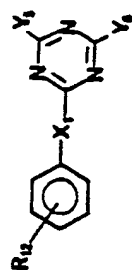
Analysis:  $C_{10}H_7Cl_2N_3S$   
Calculated: C, 44.13; H, 2.59; N, 15.44  
Found: C, 44.24; H, 2.61; N, 15.34

This compound is referred to hereinafter as Compound 1.

#### Example II

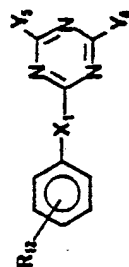
In a manner similar to that employed in Example I, other compounds were prepared. The structures and analytical data for Compounds 2 through 36, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table A below. Compound 18 was obtained from Maybridge Chemical Company, Limited, Trevillet, Tintagel, Cornwall, United Kingdom, and was recrystallized three times from hexane.

TABLE A  
Representative Heterocyclic Nitrogen - Containing Compounds



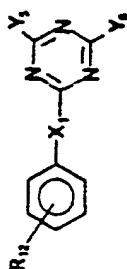
Compound No.	Substituents				Elemental Analysis						Melting Point (°C)
	R <sub>12</sub>	X <sub>1</sub>	Y <sub>5</sub>	Y <sub>6</sub>	Calculated		Found				
					C	H	N	C	H	N	
2	2,6-Cl <sub>2</sub>	0	Cl	Cl	34.76	0.97	13.51	35.35	0.90	13.57	135-138
3	2,3,4,5-Cl <sub>4</sub>	0	Cl	Cl	28.46	0.27	11.06	29.45	0.36	11.01	138-140
4	4-(CH <sub>3</sub> ) <sub>3</sub> C-	0	Cl	Cl	52.37	4.39	14.09	52.22	4.30	13.87	8p 210-220/4mm
5	4-C <sub>6</sub> H <sub>5</sub> CO-	0	Cl	Cl	55.51	2.62	12.14	54.91	2.75	12.69	129-131
6	4-CH <sub>3</sub> OC- 0	0	Cl	Cl	44.02	2.35	14.00	44.14	2.25	14.06	133-135
7	4-CH <sub>3</sub> O-CCH <sub>2</sub> - 0	0	Cl	Cl	45.88	2.89	13.38	45.98	2.58	13.56	103-104
8	3-NO <sub>2</sub>	0	Cl	Cl	37.65	1.40	19.52	38.18	1.45	19.52	135-137
9	4-(C <sub>6</sub> H <sub>5</sub> ) <sub>3</sub> C-	0	Cl	Cl	69.43	3.95	8.68	70.67	4.03	9.00	187-190
10	3,4-OC <sub>2</sub> H <sub>5</sub>	0	Cl	Cl	41.98	1.76	14.69	43.60	1.95	14.35	140-142
11	4-CH <sub>3</sub> CO-	0	Cl	Cl	46.50	2.48	14.79	47.47	2.65	14.58	137-139
12	3-CH <sub>3</sub> CONH-	0	Cl	Cl	44.17	2.70	18.73	43.82	3.00	18.58	137-139
13	4-CH <sub>3</sub> S-	0	Cl	Cl	41.68	2.45	14.58	41.12	2.38	14.31	121-123

TABLE A (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Compound No.	R <sub>12</sub>	Substituents			Elemental Analysis					Melting Point (°C)	
		X <sub>1</sub>	Y <sub>5</sub>	Y <sub>6</sub>	Calculated		Found				
					C	H	C	H	N		
14	4-CN	0	Cl	Cl	44.97	1.50	20.98	46.81	1.62	20.98	185-187
15	3-CN	0	Cl	Cl	44.97	1.50	20.98	45.28	1.69	20.98	139-143
16	2-CH <sub>3</sub> O-4-CH <sub>2</sub> CH=CH <sub>2</sub>	0	Cl	Cl	50.02	3.55	13.46	50.20	3.69	13.83	100-102
17	3-F	0	Cl	Cl	NMR (CDCl <sub>3</sub> ): δ 6.80-7.50 PPM (m, aromatic protons)						83.5-84
18	4-F	0	Cl	Cl	41.57	1.55	16.16	42.05	1.84	15.84	107-108
19	4-Cl-2-CH(CH <sub>3</sub> )C <sub>6</sub> H <sub>5</sub>	0	Cl	Cl	53.64	3.18	11.04	53.53	3.43	11.28	Bp 240/2 mm
20	4-Cl	S	Cl	Cl	36.94	1.38	14.36	37.01	1.38	14.29	116-118
21	3-Cl	S	Cl	Cl	36.94	1.38	14.36	32.79	2.44	12.98	101-102
22	2,6-Cl <sub>2</sub>	S	Cl	Cl	33.05	0.92	12.85	33.23	0.73	13.00	114-116
23	4-F	S	Cl	Cl	39.15	1.46	15.22	37.32	1.69	15.01	112-114
24	4-CH <sub>3</sub> O-	S	Cl	Cl	41.68	2.45	14.58	41.44	2.61	14.60	98-100
25	H	0	Cl	Cl	NMR (CDCl <sub>3</sub> ): δ 7.1-7.7 PPM (complex multiplet, aromatic protons)						112-114
26	4-Cl	0	Cl	Cl	NMR (CDCl <sub>3</sub> ): δ 7.07-7.60 PPM (AB quartet, aromatic protons)						108-111
27	4-CH <sub>3</sub>	0	Cl	Cl	NMR (CDCl <sub>3</sub> ): δ 3.85 PPM (3H, s, CH <sub>3</sub> ), 6.85-7.32 PPM (4H, m, aromatic protons)						90-93

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Representative Heterocyclic Nitrogen - Containing Compounds

Compound No.	Substituents				Elemental Analysis						Melting Point (°C)
	R12	X1	Y5	Y6	Calculated		Found				
					C	H	C	H	N		
28	4-CH3O	0	Cl	Cl	44.14	2.59	15.44	44.29	2.89	15.23	105-108
29	3,4-Cl2	0	Cl	Cl	34.76	0.97	13.51	35.32	1.22	12.91	115-119
30	3-Cl	0	Cl	Cl	39.09	1.46	15.20	39.11	1.56	15.37	79-83
31	4-CF3	0	Cl	Cl	38.73	1.30	13.55	39.01	1.59	13.64	91-95
32	4-C6H5O	0	Cl	Cl	53.91	2.71	12.58	53.96	2.92	12.69	116-118
33	4-NO2	0	Cl	Cl	37.65	1.40	19.52	38.58	1.20	19.74	197-200
34	2,4-F2	0	Cl	2,4-F2-C6H3O	50.65	1.70	11.81	49.04	1.53	11.30	165-168.5
35	2,4-Cl2	S	Cl	Cl	33.06	0.92	12.85	33.28	1.14	12.64	88-89
36	2,6-Cl2-4-NO2	0	Cl	Cl	30.37	0.57	15.74	29.73	0.71	16.00	144-148

SUBSTITUTE SHEET

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Example IIIPreparation of 2,4-dichloro-6-(2',3'-dichloro-  
phenoxy)-1,3,5-triazine

Into a solution containing 18.4 grams (0.1 mole) of cyanuric chloride in 150 milliliters of acetone was added, with cooling at a temperature of 0-5°C and magnetic stirring, a solution containing 16.3 grams (0.1 mole) of 2,3-dichloro-phenol and 14.3 grams (0.1 mole) of quinaldine in 50 milliliters of acetone. The solution was added at such a rate to maintain the reaction temperature at 0-5°C. The resulting mixture was magnetically stirred for a period of one hour, allowed to warm to room temperature, and precipitated quinaldine hydrochloride was filtered off and washed with acetone. The combined filtrates were then poured onto ice and the resulting precipitated solid was collected by filtration. The solid was washed with 100 milliliters of 10% aqueous NaOH and then 100 milliliters of water. After drying, the solid was crystallized from hexane to give a crude yield of 14.5 grams. This material was further purified by vacuum sublimation to give 1.7 grams (0.005 mole) of 2,4-dichloro-6-(2',3'-dichloro-phenoxy)-1,3,5-triazine having a melting point of 154.5°C-156°C. Elemental analysis of the product indicated the following:

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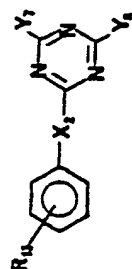
Analysis:  $C_9H_3Cl_4N_3O$   
Calculated: C, 34.76; H, 0.97; N, 13.51  
Found: C, 34.30; H, 0.89; N, 13.80.

This compound is referred to hereinafter as Compound 37.

Example IV

In a manner similar to that employed in Example III, other compounds were prepared. The structures and analytical data for Compounds 38 through 45, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table B below.

TABLE B  
Representative Heterocyclic Nitrogen - Containing Compounds



Compound No.	Substituents				Elemental Analysis						Melting Point (°C)
	R <sub>13</sub>	X <sub>2</sub>	Y <sub>7</sub>	Y <sub>8</sub>	Calculated		Found		N		
					C	H	C	H			
38	2-NO <sub>2</sub>	0	Cl	Cl	37.65	1.40	37.04	1.25	19.52	19.66	132-135
39	2-Cl	0	Cl	Cl	39.09	1.46	39.01	1.49	15.20	15.80	92-95
40	2,5-Cl <sub>2</sub>	0	Cl	Cl	34.76	0.97	34.64	0.76	13.51	13.92	118-120
41	Cl <sub>5</sub>	0	Cl	Cl	26.09	--	27.41	--	10.14	10.07	205-208
42	2-CH <sub>3</sub> -4-Cl	0	Cl	Cl	41.34	2.08	41.75	2.26	14.46	14.57	82-83
43	4-(n-C <sub>12</sub> H <sub>25</sub> -O-CO)-	0	Cl	Cl	58.15	6.43	58.04	6.19	9.25	9.12	88-90
44	2,4-Cl <sub>2</sub>	0	Cl	Cl	34.76	0.97	34.78	1.04	13.51	13.49	121-122
45	4-C <sub>6</sub> H <sub>5</sub> CH-CHCO-	0	Cl	Cl	58.08	2.98	58.21	3.57	11.29	11.35	169-171



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Example VPreparation of 2-chloro-4,6-bis(2',4'-dichloro-  
phenoxy)-1,3,5-triazine

Into a solution containing 9.2 grams (0.05 mole) of cyanuric chloride in 100 milliliters of acetone was added, with cooling at a temperature of 0-5°C and magnetic stirring, 8.15 grams (0.05 mole) of 2,4-dichlorophenol and 7.25 grams (0.05 mole) of potassium carbonate. The ingredients were added at such a rate to maintain the reaction temperature at 0-5°C. The mixture was poured onto ice and the resulting solid precipitate was collected by filtration, washed with 100 milliliters of 10% aqueous sodium hydroxide and then with water. After drying, the solid was recrystallized from hexane. The first crop of crystals was recrystallized twice from hexane to give 2.0 grams (0.005 mole) of 2-chloro-4,6-bis(2',4'-dichlorophenoxy)-1,3,5-triazine having a melting point of 165°C-168°C. Elemental analysis of the product indicated the following:

Analysis:	$C_{15}H_6Cl_5N_3O_2$
Calculated:	C, 41.18; H, 1.38; N, 9.60
Found:	C, 41.41; H, 0.96; N, 9.86

This compound is referred to hereinafter as Compound  
46.

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Example VIPreparation of 2,4-dichloro-6-(3',5'-dichloro-phenoxy)-1,3,5-triazine

Into a stirred solution containing of 5.24 grams (0.032 mole) of 3,5-dichlorophenol in 15 milliliters of acetone, which was cooled to a temperature of 0-5°C, was added 3.45 grams (0.032 mole) of 2,6-lutidine followed by a solution of 5.93 grams (0.032 mole) of cyanuric chloride in 185 milliliters of acetone. The cyanuric chloride/acetone solution was added dropwise, while maintaining the temperature at 0-5°C. After completing the feed, stirring was continued at a temperature of about 0°C for a period of one hour and the mixture was then warmed to ambient temperature. Lutidine hydrochloride was removed by filtration and the filtrate was treated with charcoal and filtered through Celite. The acetone solution was freed of solvent under reduced pressure and the residue dissolved in toluene. This solution was washed with 0.5 N NaOH (twice), then with water, dried over  $\text{MgSO}_4$  and evaporated in vacuo to give 9.1 grams of a crude solid product. Recrystallization from hexane and vacuum sublimation gave 1.0 gram (0.003 mole) of pure 2,4-dichloro-6-(3',5'-dichlorophenoxy)-1,3,5-triazine having a melting point of 109°C-111°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_9H_3Cl_4ON_3$   
Calculated: C, 34.76; H, 0.97; N, 13.51  
Found: C, 34.41; H, 0.90; N, 13.33

This compound is referred to hereinafter as Compound 47.

#### Example VII

##### Preparation of 4,6-dichloro-2-(3'-dimethylamino-phenoxy)-1,3,5-triazine and 6-chloro-2,4-bis-(3'-dimethylaminophenoxy)-1,3,5-triazine

Into a suspension containing 4.2 grams (0.09 mole) of NaH (50% in oil) in 100 milliliters of dry tetrahydrofuran was added dropwise a solution containing 10.0 grams (0.07 mole) of 3-(N,N-dimethylamino)phenol in 200 milliliters of dry tetrahydrofuran at a temperature of 4°C. The mixture was warmed to room temperature, transferred into an addition funnel and added dropwise into a solution containing 13.4 grams (0.07 mole) of cyanuric chloride in 100 milliliters of dry tetrahydrofuran at 0°C. This mixture was stirred at 0°C for a period of 3 hours, evaporated, and the residue extracted with hot  $CH_2Cl_2$ . The  $CH_2Cl_2$  solution was evaporated and the residue purified by flash column chromatography on Florisil® using 5% EtOAc in hexane to give 1.70 grams (0.004 mole), after recrystallization from EtOAc-hexane, of 6-chloro-2,4-bis-

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(3'-dimethylaminophenoxy)-1,3,5-triazine having a melting point of 134°C-136.5°C and 0.65 gram (0.002 mole) of 4,6-dichloro-2-(3'-dimethylaminophenoxy)-1,3,5-triazine as an oil. Elemental analysis of these two products indicated the following:

4,6-dichloro-2-(3'-dimethylaminophenoxy)-1,3,5-triazine

Analysis:  $C_{11}H_{10}Cl_2N_4O$   
Calculated: C, 46.34; H, 3.53; N, 19.65;  
Cl, 24.87  
Found: C, 48.69; H, 3.74; N, 17.17;  
Cl, 20.88

This compound is referred to hereinafter as Compound 48.

6-chloro-2,4-bis-(3'-dimethylaminophenoxy)-1,3,5-triazine

Analysis:  $C_{19}H_{20}ClN_5O_2$   
Calculated: C, 59.14; H, 5.22; N, 18.15; O,  
8.28; Cl, 9.19  
Found: C, 58.52; H, 5.04; N, 17.85; O,  
8.90; Cl, 9.46

This compound is referred to hereinafter as Compound 49.

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Example VIIIPreparation of 4,6-dichloro-2-(4'-bromo-3',5'-  
dimethylphenoxy)-1,3,5-triazine

Into a solution containing 9.2 grams (0.05 mole) of cyanuric chloride in 80 milliliters of acetone was added 5.8 milliliters of 2,6-lutidine dissolved in 10 milliliters of acetone at a temperature of -60°C. A solution of 10.0 grams (0.05 mole) of 4-bromo-3,5-dimethylphenol in 30 milliliters of acetone was then added while maintaining the temperature at -60°C. The mixture was stirred for 1 hour at -60°C, 30 minutes at room temperature, and then filtered and the precipitate washed with acetone. The filtrate was poured onto ice and the resulting precipitate was collected by suction filtration. The crude product was washed with water and crystallized from hot hexane to give 1.49 grams (0.004 mole) of 4,6-dichloro-2-(4'-bromo-3',5'-dimethylphenoxy)-1,3,5-triazine as pink-orange crystals having a melting point of 149°C-151°C. Elemental analysis of the product indicated the following:

Analysis:	$C_{11}H_8BrCl_2N_3O$
Calculated:	C, 37.86; H, 2.31; N, 12.04
Found:	C, 38.63; H, 2.47; N, 11.55

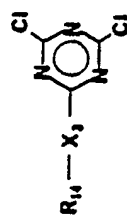
This compound is referred to hereinafter as Compound 50.

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Example IX

In a manner similar to that employed in Example VIII, other compounds were prepared. The structures and analytical data for Compounds 51 through 61, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table C below. For the preparation of Compound 61, triisopropanolamine was used as the acid-acceptor in place of 2,6-lutidine.

TABLE C  
Representative Heterocyclic Nitrogen - Containing Compounds





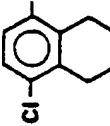
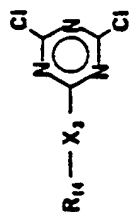
Compound No.	Substituents		Elemental Analysis						Melting Point (°C)
	R <sub>14</sub>	X <sub>3</sub>	Calculated			Found			
			C	H	N	C	H	N	
51	 O=CH-	0	44.47	1.87	15.56	44.75	2.02	16.06	140-141
52		0	56.63	2.85	13.21	56.01	2.68	13.37	189
53		0	49.32	3.18	8.85	47.92	3.05	12.68	121-123

TABLE C (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



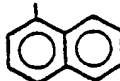
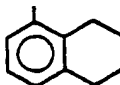
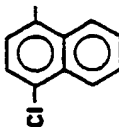
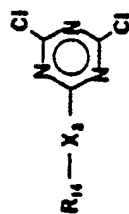
Compound No.	Substituents		Elemental Analysis						Melting Point (°C)
	R <sub>14</sub>	X <sub>3</sub>	Calculated			Found			
			C	H	N	C	H	N	
54		0	53.45	2.41	--	53.60	2.82	--	92.5-93.5
55		0	52.72	3.74	14.19	51.55	4.18	14.56	133-139
56		0	47.82	1.85	12.87	48.82	1.95	12.45	126-127



TABLE C (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds




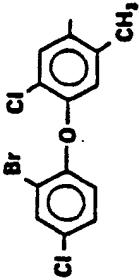

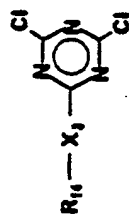
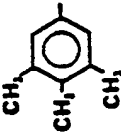
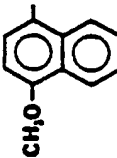
Compound No.	Substituents		Elemental Analysis						Melting Point (°C)
	R <sub>14</sub>	X <sub>3</sub>	Calculated			Found			
			C	H	N	C	H	N	
57		0	53.45	2.41	14.38	52.65	2.61	13.97	154-155
58		NH	38.83	1.83	11.32	39.18	1.95	11.45	172-174
59		0	30.41	0.85	11.82	<sup>13</sup> C NMR (CDCl <sub>3</sub> ) δ 116.366, 123.788, 128.881, 129.179; 133.513, 147.137, 170.460, 173.331 PPM.			126

TABLE C (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Compound No.	Substituents		Elemental Analysis						Melting Point (°C)
	R <sub>14</sub>	X <sub>3</sub>	Calculated			Found			
			C	H	N	C	H	N	
60		0	50.72	3.90	14.79	51.34	4.09	14.90	147-149
61		0	52.20	2.82	13.04	52.28	2.96	13.08	176-177.5

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Example XPreparation of 4,6-dichloro-2-(2'-phenylphenoxy)-  
1,3,5-triazine

Into a magnetically stirred solution containing 10.83 grams (0.06 mole) of cyanuric chloride in 100 milliliters of acetone was added a solution containing of 11.24 grams (0.06 mole) of triisopropanolamine in 100 milliliters of acetone at a temperature of  $-70^{\circ}\text{C}$ . A solution of 10.0 grams (0.06 mole) of 2-phenylphenol in 100 milliliters of acetone was then added dropwise at a temperature of  $-70^{\circ}\text{C}$ . This mixture was stirred at room temperature for a period of 1 hour, filtered, and the filtrate poured onto ice-water. After removal of the acetone solvent by evaporation, the resulting mixture was partitioned between water and  $\text{CH}_2\text{Cl}_2$ , the organic layer separated, dried using anhydrous  $\text{Na}_2\text{SO}_4$  and evaporated. The residual product was purified by flash column chromatography using silica gel, and eluted with 5% ethyl acetate in hexane to give 6.0 grams (0.02 mole) of 4,6-dichloro-2-(2'-phenylphenoxy)-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis:	$\text{C}_{15}\text{H}_9\text{Cl}_2\text{N}_3\text{O}$
Calculated:	C, 56.63; H, 2.85; N, 13.21; Cl, 22.29
Found:	C, 55.65; H, 2.99; N, 13.46; Cl, 24.18

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This compound is referred to hereinafter as Compound 62.

Example XI

Preparation of 2,4-dichloro-6-  
(2'-chlorophenylamino)-1,3,5-triazine

In a manner similar to Example VIII, 4.63 grams (0.04 mole) of 2-chloroaniline and 6.69 grams (0.04 mole) of cyanuric chloride were reacted in the presence of 3.89 grams (0.04 mole) of 2,6-lutidine except that the cooling bath was removed at the end of the feed period and the stirred mixture allowed to warm to room temperature. After filtering off lutidine hydrochloride, the filtrate was freed of acetone solvent under reduced pressure and the resulting solid was crystallized from a mixture of hexane and benzene. The first crop of product yielded 1.1 grams (0.004 mole) of 2,4-dichloro-6-(2'-chlorophenyl-amino)-1,3,5-triazine having a melting point of 153°C-156°C. NMR analysis of the product indicated the following: NMR (CDCl<sub>3</sub>): 7.0-8.35 ppm (complex multiplet, aromatic and NH). This compound is referred to hereinafter as Compound 63.

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Example XIIPreparation of 2,4-dichloro-6-  
(4'-chlorophenylamino)-1,3,5-triazine

In a manner similar to Example XI, 6.94 grams (0.05 mole) of 4-chloroaniline, 10.04 grams (0.05 mole) of cyanuric chloride and 5.83 grams (0.05 mole) of 2,6-lutidine were reacted in acetone solution. On completing the feed, the reaction mixture was stirred for about 1 hour at a temperature of 0°C and then at room temperature for about 16 hours. Work up furnished after water-washing and drying 14.0 grams (0.05 mole) of 2,4-dichloro-6-(4'-chlorophenylamino)-1,3,5-triazine having a melting point of 181°C-184°C. NMR analysis of the product indicated the following: <sup>13</sup>C NMR (d<sub>6</sub> acetone) 171.38, 165.29, 136.74, 130.56, 129.72, 123.79 ppm.

This compound is referred to hereinafter as Compound 64.

Example XIIIPreparation of 2,4-dichloro-6-  
(5',6',7',8'-tetrahydronaphthyl-1'-amino)-  
1,3,5-triazine

Into a stirred solution containing cyanuric chloride (5.0 grams, 0.03 mole) in acetone (120 milliliters) at a temperature of 0°C was added

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dropwise a solution containing 2,6-lutidine (3.15 milliliters, 0.03 mole) and 1-amino-5,6,7,8-tetrahydronaphthalene (3.97 grams, 0.03 mole) in acetone (200 milliliters). After 2 hours at 0°C, the reaction mixture was warmed to room temperature and stirred for a period of 1 hour. The reaction mixture was filtered, and the filtrate was filtered through silica gel and washed with acetone to afford 2,4-dichloro-6-(5',6',7',8'-tetrahydronaphthyl-1'-amino)-1,3,5-triazine as a solid (7.0 grams, 0.02 mole) having a melting point of 158°C-162°C. Elemental analysis of the product indicated the following:

Analysis:	$C_{13}H_{12}Cl_2N_4$
Calculated:	C, 52.89; H, 4.10; N, 18.98.
Found:	C, 53.03; H, 4.06; N, 18.89

This compound is referred to hereinafter as Compound 65.

#### Example XIV

##### Preparation of 4,6-dichloro-2-(4'-nitrophenylamino)-1,3,5-triazine

Into a solution containing 20 grams (0.11 mole) of cyanuric chloride in 300 milliliters of acetone was added a solution containing 15.0 grams (0.11 mole) of p-nitroaniline in 200 milliliters of acetone and a solution containing 12.6 milliliters (0.11 mole) of 2,6-lutidine in 100 milliliters of

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acetone. The resulting mixture was stirred at room temperature under a nitrogen atmosphere for about 16 hours. The mixture was then filtered, the filtrate poured onto ice-water, and the resulting precipitate collected to give 5.6 grams of a crude product. The crude product was recrystallized from acetone-toluene to give 3.72 grams (0.01 mole) of 4,6-dichloro-2-(4'-nitrophenylamino)-1,3,5-triazine as a yellow solid having a melting point of 240°C (dec.). Elemental analysis of the product indicated the following:

Analysis:	$C_9H_5N_5O_2Cl_2$
Calculated:	C, 37.79; H, 1.76; N, 24.48; O, 11.19; Cl, 24.79
Found:	C, 38.04; H, 2.01; N, 24.20; O, 11.14; Cl, 23.74

This compound is referred to hereinafter as Compound 66.

#### Example XV

##### Preparation of 4,6-dibromo-2-(4'-nitrophenylamino)- 1,3,5-triazine

Into a solution containing 600 milligrams (0.002 mole) of 4,6-dichloro-2-(4'-nitrophenylamino)-1,3,5-triazine prepared in Example XIV in 300 milliliters of  $CH_2Cl_2$  was bubbled HBr gas at room temperature for a period of 4 hours. The

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resulting mixture was stored in a refrigerator for about 48 hours and an oil, which separated from  $\text{CH}_2\text{Cl}_2$ , was collected by decantation. The oil was rinsed with  $\text{CH}_2\text{Cl}_2$  (3 X 20 milliliters) and then recrystallized from toluene to give 600 milligrams (0.002 mole) of 4,6-dibromo-2-(4'-nitrophenylamino)-1,3,5-triazine as a yellow solid. Elemental analysis of the product indicated the following:

Analysis:  $\text{C}_9\text{H}_5\text{N}_3\text{O}_2\text{Br}_2$

Calculated:

C, 28.81; H, 1.34; N, 18.67

Found: C, 29.85; H, 2.75; N, 18.85

This compound is referred to hereinafter as Compound 67.

#### Example XVI

#### Preparation of 4,6-dibromo-2-(4'-chlorophenylamino)-1,3,5-triazine

In a manner similar to Example XV, 4,6-dichloro-2-(4'-chlorophenylamino)-1,3,5-triazine was reacted with hydrogen bromide to give 4,6-dibromo-2-(4'-chlorophenylamino)-1,3,5-triazine having a melting point of 197.5°C-200°C. Elemental analysis of the product indicated the following.



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Analysis:  $C_9H_5N_4ClBr_2$   
Calculated: C, 29.66; H, 1.39; N, 15.38;  
Cl, 9.73; Br, 43.85  
Found: C, 29.49; H, 1.48; N, 15.19;  
Cl, 9.36; Br, 43.40

This compound is referred to hereinafter as Compound 68.

Example XVII

Preparation of 2-(4'-chlorophenylamino)-4,6-difluoro-1,3,5-triazine

Into a stirred solution containing 16.21 grams (0.12 mole) of cyanuric fluoride in 120 milliliters of toluene was added, with cooling at a temperature of  $-10^{\circ}\text{C}$  to  $0^{\circ}\text{C}$ , a solution of 12.75 grams (0.10 mole) of 4-chloroaniline in 120 milliliters of toluene over a period of 2 hours. The mixture was then stirred at room temperature for 15 minutes and at a temperature of  $50^{\circ}\text{C}$  for 30 minutes. After filtering, the filtrate was reduced to one-half in volume by rotary vacuum evaporation of the solvent. The crystalline crude product (12.6 grams) was separated from the concentrated solution and, following filtering and drying, was recrystallized from toluene to give 6.3 grams (0.03 mole) of 2-(4'-chlorophenylamino)-4,6-difluoro-1,3,5-triazine as white crystals having a melting point of  $144^{\circ}\text{C}$ - $147^{\circ}\text{C}$ . NMR analysis of the product

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indicated the following:  $^{13}\text{C}$  NMR ( $\text{d}_6$  acetone)  $\delta$   
177.09 (m), 168.21 (m), 130.75, 129.75, 124.12 ppm.

This compound is referred to hereinafter as Compound 69.

#### Example XVIII

##### Preparation of 4-chloro-6-iodo-2-(2',4'- dichlorophenoxy)-1,3,5-triazine

Into a suspension containing 6.0 grams (0.02 mole) of 4,6-dichloro-2-(2',4'-dichlorophenoxy)-1,3,5-triazine in 60 milliliters of acetone was added a solution containing 5.8 grams (0.04 mole) of NaI in 60 milliliters of acetone. The resulting mixture was stirred and heated to a temperature of 90°C in a sealed bottle for a period of 6 hours. The mixture was then filtered, the filtrate evaporated to give 9.2 grams of solid, and 40 milliliters of methylene chloride was added to this solid and the suspension then filtered. The filtrate was evaporated and the residue was sublimed in vacuo at 90°C for 10 hours. The temperature was then raised to 160°C-190°C and 2.0 grams of off-white solid was collected from the cold finger. This solid was recrystallized from  $\text{CH}_3\text{CN}$  - water to give 1.0 gram (0.002 mole) of 4-chloro-6-iodo-2-(2',4'-dichlorophenoxy)-1,3,5-triazine as a white solid having a melting point of 155°C-158°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_9H_3Cl_3IN_3O$   
Calculated: C, 26.84; H, 0.75; N, 10.44;  
I, 31.54.  
Found: C, 26.87; H, 0.77; N, 10.27;  
I, 30.61

This compound is referred to hereinafter as Compound 70.

Example XIX

Preparation of 4,6-dibromo-2-(2',4'-dichlorophenoxy)-1,3,5-triazine

A 4.0 gram (0.01 mole) portion of 2,4-dichloro-6-(2',4'-dichlorophenoxy)-1,3,5-triazine prepared in a manner similar to Example III was dissolved in 200 milliliters of toluene. HBr gas was continuously bubbled through the refluxing mixture for a period of 5 hours. The reaction mixture was cooled to room temperature and nitrogen gas was bubbled through the mixture to remove any excess HBr. The reaction mixture was then evaporated to dryness and the residue recrystallized from  $CH_2Cl_2$ /hexane to give 1.97 grams (0.005 mole) of 4,6-dibromo-2-(2',4'-dichlorophenoxy)-1,3,5-triazine as silver gray crystals having a melting point of 174°C-176°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_9H_3Br_2Cl_2N_3O$ Calculated: C, 27.00; H, 0.75; N, 10.50;  
Cl, 17.50Found: C, 27.41; H, 0.65; N, 10.01;  
Cl, 16.70

This compound is referred to hereinafter as Compound 71.

Example XX

Preparation of 2-(4'-chlorophenoxy)-4,6-  
difluoro-1,3,5-triazine

Into a stirred solution containing 3.91 grams (0.03 mole) of cyanuric fluoride in 150 milliliters of acetone was added dropwise a mixture containing 3.72 grams (0.03 mole) of 4-chlorophenol and 3.10 grams (0.03 mole) of 2,6-lutidine at a temperature of 0°C. After stirring for about 16 hours, the reaction mixture was poured onto ice causing an oil to separate. The oil was taken up into ether, washed with 0.5 N NaOH, then water, and dried. Evaporation gave a white solid, which was recrystallized from hexane and vacuum sublimed to give 0.47 gram (0.002 mole) of 2-(4'-chlorophenoxy)-4,6-difluoro-1,3,5-triazine having a melting point of 81°C-82.5°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_9H_9ClFN_3O_4$   
Calculated: C, 44.74; H, 1.67; N, 17.39  
Found: C, 44.80; H, 1.72; N, 17.23

This compound is referred to hereinafter as Compound 72.

Example XXI

Preparation of 2-fluoro-4,6-bis-(4'-chlorophenoxy)-1,3,5-triazine

Into a mixture containing 3.72 grams (0.03 mole) of 4-chlorophenol and 3.10 grams (0.03 mole) of 2,6-lutidine in 15 milliliters of acetone was added, with magnetic stirring and cooling at a temperature of 0-5°C, a solution containing 3.91 grams (0.03 mole) of cyanuric fluoride in 185 milliliters of acetone. After stirring at a temperature of 0-5°C for one hour, the mixture was stirred at ambient temperature for about 70 hours. The mixture was then stirred and heated under reflux for about 28 hours, cooled to room temperature and poured onto ice to give a solid. The solid was water-washed, taken up in toluene and the resulting solution washed successively with 0.5 N NaOH and water, then dried over  $MgSO_4$  and evaporated under reduced pressure. The resulting solid was recrystallized from hexane to give 1.20 grams (0.003 mole) of a first crop of 2-fluoro-4,6-bis-(4'-chlorophenoxy)-1,3,5-triazine having a melting

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point of 149°C-150°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{15}H_8N_3O_2Cl_2F$

Calculated: C, 51.15; H, 2.29; N, 11.93; F, 5.39

Found: C, 51.20; H, 2.21; N, 11.89; F, 5.16

This compound is referred to hereinafter as Compound 73.

#### Example XXII

##### Preparation of 2,4-dichloro-6-(4'-sec-butyl oxyphenoxy)-1,3,5-triazine

##### Part A: Preparation of 4-(sec-butyl

oxy)phenol  
Into a 500 milliliter round bottom flask under a nitrogen atmosphere was added NaOH (2.91 grams, 0.07 mole) and 125 milliliters of 1:1 water/dioxane (degassed). When all of the NaOH had dissolved, hydroquinone (4.0 grams, 0.04 mole) was added and the resulting solution immediately turned dark brown. At this time, 2-iodobutane (4.15 milliliters, 0.04 mole) dissolved in 5 milliliters of dioxane was added and the mixture was stirred for 72 hours at room temperature and then acidified with 10% aqueous HCl solution to a pH of about 2. The aqueous solution was extracted with EtOAc (2 x 150 milliliters) and the combined extracts were washed

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with water, saturated NaCl, dried ( $\text{MgSO}_4$ ) and concentrated in vacuo to give a crude product mixture. This mixture was purified by flash chromatography to give a small amount of dialkylated product. 2.31 grams (0.01 mole) of 4-(sec-butyloxy)-phenol and starting hydroquinone in order of elution. NMR analysis of the product indicated the following: NMR ( $\text{CDCl}_3$ )  $\delta$  0.95 (t, 3H, J=7Hz), 1.29 (d, 3H, J=6Hz), 1.29-1.40 (m, 2H), 4.12 (sextet, 1H, J=6Hz), 6.35 (br s, 1H), 6.72 (s, 4H) ppm.

Part B: Preparation of 2,4-dichloro-6-(4'-sec-butyloxyphenoxy)-1,3,5-triazine

Into a 100 milliliter 3-necked round bottom flask equipped with a thermometer, addition funnel and nitrogen inlet was added cyanuric chloride (2.22 grams, 0.01 mole) dissolved in 20 milliliters of acetone. After cooling to a temperature of 0-5°C, 4-(sec-butyloxy) phenol (2.0 grams, 0.01 mole) prepared in Part A and 2,6-lutidine (1.40 milliliters, 0.01 mole) dissolved in 20 milliliters of acetone were slowly added dropwise via the addition funnel. The temperature of the reaction was maintained between 0-5°C during the addition. The reaction mixture was then stirred at room temperature for a period of 16 hours. After this period, the reaction mixture was filtered through a Celite pad and the pad rinsed with acetone. Ice-water was added and the oil which precipitated was extracted with EtOAc. The EtOAc layers were washed with water, dried ( $\text{MgSO}_4$ ) and concentrated to give a brown semi-solid. The crude product was

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purified by flash chromatography on silica (eluent 10% EtOAc/hexane) to give 2.43 grams (0.008 mole) of 2,4-dichloro-6-(4'-sec-butyloxyphenoxy)-1,3,5-triazine as pale yellow crystals having a melting point of 52.0°C-55.0°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{13}H_{13}Cl_2N_3O_2$

Calculated: C, 49.70; H, 4.17; N, 13.37

Found: C, 50.26; H, 4.51; N, 13.10

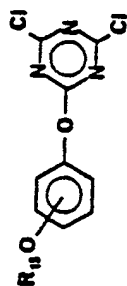
This compound is referred to hereinafter as Compound 74.

#### Example XXIII

In a manner similar to that employed in Example XXII, other compounds were prepared. The structures and analytical data for Compounds 75 through 83, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table D below.



TABLE D  
Representative Heterocyclic Nitrogen - Containing Compounds






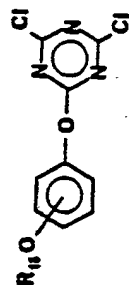


Compound No.	Substituents	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
75	4-n-C <sub>4</sub> H <sub>9</sub>	49.70	4.17	13.37	49.66	4.27	13.32	51.0-52.5
76	4-n-C <sub>7</sub> H <sub>15</sub>	53.94	5.38	11.80	53.96	5.33	11.87	51.5-53.5
77		52.96	4.44	12.35	53.30	4.58	12.02	95.0-96.0
78		55.19	3.18	12.07	55.98	3.42	11.22	130.5-132.5
79		62.28	3.56	9.90	60.82	3.74	10.28	174.0-176.0

TABLE D (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Compound No.	Substituents	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
80	3-CH <sub>3</sub>	44.14	2.59	15.44	44.13	2.67	15.68	86.0-89.0
81	3-n-C <sub>4</sub> H <sub>9</sub>	49.70	4.17	13.37	49.92	4.49	13.42	46.0-48.0
82		52.96	4.44	12.35	52.51	4.41	12.69	011
83		55.19	3.18	12.06	59.64	3.89	10.28	011

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Example XXIVPreparation of 4-chloro-6-methyl-2-(2',4'-  
dichlorophenoxy)-1,3,5-triazine

Into a solution containing 5.0 grams (0.02 mole) of 2,4-dichloro-6-(2',4'-dichlorophenoxy)-1,3,5-triazine prepared in a manner similar to Example III in 400 milliliters of dry tetrahydrofuran was added dropwise 5.9 milliliters of a 2.7M solution of methylmagnesium bromide in ether at a temperature of 0°C. The resulting mixture was stirred at room temperature under a nitrogen atmosphere for about 18 hours. The mixture was concentrated and the residue purified by flash column chromatography on silica gel using 10% EtOAc in hexane to give 2.00 grams (0.007 mole) of 4-chloro-6-methyl-2-(2',4'-dichlorophenoxy)-1,3,5-triazine having a melting point of 107°C-108°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{10}H_6Cl_3N_3O$   
Calculated: C, 41.34; H, 2.08; N, 14.46;  
Cl, 36.61  
Found: C, 41.35; H, 2.39; N, 14.46;  
Cl, 36.85

This compound is referred to hereinafter as Compound 84.

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Example XXVPreparation of 4-bromo-6-methyl-2-(2',4'-dichlorophenoxy)-1,3,5-triazine

Into a solution containing 2.0 grams (0.007 mole) of 4-chloro-6-methyl-2-(2',4'-dichlorophenoxy)-1,3,5-triazine prepared in Example XXIV in 300 milliliters of  $\text{CH}_2\text{Cl}_2$  was bubbled dry HBr gas for a period of 3 hours. The mixture was allowed to stand at room temperature for about 18 hours. The suspension was then filtered and the solids partitioned between  $\text{NaHCO}_3$  solution and  $\text{CH}_2\text{Cl}_2$ . The organic layer was dried over anhydrous  $\text{Na}_2\text{SO}_4$  and the solvent evaporated to give 0.7 gram (0.002 mole) of 4-bromo-6-methyl-2-(2',4'-dichlorophenoxy)-1,3,5-triazine having a melting point of 123°C-127°C. Elemental analysis of the product indicated the following:

Analysis:  $\text{C}_{10}\text{H}_6\text{BrCl}_2\text{N}_3\text{O}$

Calculated: C, 35.85; H, 1.81; N, 12.54;  
Cl, 21.17; Br, 23.85

Found: C, 36.22; H, 2.15; N, 12.46;  
Cl, 22.00; Br, 21.20

This compound is referred to hereinafter as Compound 85.

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Example XXVIPreparation of 4-chloro-6-methyl-2-  
(1-naphthoxy)-1,3,5-triazine

Into a solution containing 5.0 grams (0.02 mole) of 4,6-dichloro-2-(1-naphthoxy)-1,3,5-triazine prepared in Example IX in 300 milliliters of tetrahydrofuran at 4°C was added dropwise 7.0 milliliters of 2.7M methylmagnesium bromide in 200 milliliters of tetrahydrofuran. The resulting mixture was stirred at room temperature for about 18 hours and then evaporated. The residue was purified by flash column chromatography on silica gel using 7% ethyl acetate in hexane to give 2.0 grams (0.007 mole) of 4-chloro-6-methyl-2-(1-naphthoxy)-1,3,5-triazine having a melting point of 80°C-83°C. (recrystallized from CH<sub>2</sub>Cl<sub>2</sub>-hexane). Elemental analysis of the product indicated the following:

Analysis: C<sub>14</sub>H<sub>10</sub>ClN<sub>3</sub>O  
Calculated: C, 61.89; H, 3.71; N, 15.46; Cl, 13.05  
Found: C, 61.86; H, 3.72; N, 15.46; Cl, 13.07

This compound is referred to hereinafter as Compound 86.

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Example XXVIIPreparation of 2-chloro-4-methoxy-6-  
(2',4'-dichlorophenoxy)  
-1,3,5-triazine

Into a stirred solution containing 10.0 grams (0.03 mole) of 2,4-dichloro-6-(2',4'-dichlorophenoxy)-1,3,5-triazine in 200 milliliters of acetone was added 3.49 grams (0.03 mole) of 2,6-lutidine at a temperature of 0°C-5°C. To this mixture was added dropwise 1.03 grams (0.03 mole) of methanol while warming to room temperature. The mixture was heated to 50°C and maintained for about 6 hours, then cooled to room temperature and stirred for about 60 hours. Lutidine hydrochloride was filtered off, the solvent evaporated, and the residue dissolved in ether and dried over  $\text{MgSO}_4$ . The solution was flash chromatographed on a silica column, eluting with  $\text{CH}_2\text{Cl}_2$ /hexane (9:1). Evaporation of solvent gave 3.14 grams of crystalline product which was recrystallized from hexane to give 1.86 grams (0.006 mole) of 2-chloro-4-methoxy-6-(2',4'-dichlorophenoxy)-1,3,5-triazine having a melting point of 87°C-89°C. Elemental analysis of the product indicated the following:

Analysis:  $\text{C}_{10}\text{H}_6\text{Cl}_3\text{N}_3\text{O}_2$   
Calculated: C, 38.67; H, 1.97; N, 13.71  
Found: C, 38.94; H, 2.00; N, 14.09

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This compound is referred to hereinafter as Compound 87.

Example XXVIII

Preparation of 4,6-bis-  
(2',2',2'-trifluoroethoxy)  
-2-phenyl-1,3,5-triazine

Into a stirred suspension containing 1.06 grams (0.02 mole) of NaH (50% in oil) in 30 milliliters of dry tetrahydrofuran was added dropwise a solution containing 1.72 milliliters (0.01 mole) of 2,2,2-trifluoroethanol in 10 milliliters of dry tetrahydrofuran at a temperature of 4°C. This mixture was stirred at room temperature under a nitrogen atmosphere for 20 minutes. The mixture was then transferred into an addition funnel under a nitrogen atmosphere and added dropwise to a solution of 5.0 grams (0.02 mole) of 4,6-dichloro-2-phenyl-1,3,5-triazine in 60 milliliters of dry tetrahydrofuran at room temperature, stirred for about 18 hours and then evaporated to dryness. The residue was purified by flash column chromatography on silica gel using 2% EtOAc in hexane to give 0.9 gram of a crude product which was recrystallized from  $\text{CH}_2\text{Cl}_2$ -hexane to give 0.48 gram (0.001 mole) of 4,6-bis-(2',2',2'-trifluoroethoxy)-2-phenyl-1,3,5-triazine as white plates having a melting point of 92°C-93°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_{13}H_9N_3O_2F_6$   
Calculated: C, 44.20; H, 2.57; N, 11.89; F, 32.27  
Found: C, 44.51; H, 2.57; N, 12.03; F, 31.56

This compound is referred to hereinafter as Compound 88.

Example XXIX

Preparation of 4-chloro-6-  
(2',2',2'-trifluoroethoxy)  
-2-phenyl-1,3,5 triazine

The column chromatography fractions from Example XXVIII were examined and a group identified as containing 4-chloro-6-(2',2',2'-trifluoroethoxy)-2-phenyl-1,3,5-triazine as a second component. These were combined and purified by preparative liquid chromatography (silica gel) using 10% ethyl acetate in hexane as the eluent to give 320 milligrams (0.001 mole) of 4-chloro-6-(2',2',2'-trifluoroethoxy)-2-phenyl-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis:  $C_{11}H_7ClF_3N_3O$   
Calculated: C, 45.61; H, 2.44; N, 14.51;  
Cl, 12.24; F, 19.68  
Found: C, 45.43; H, 2.41; N, 14.45;  
Cl, 12.28; F, 18.02



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This compound is referred to hereinafter as Compound 89.

Example XXX

Preparation of 2-chloro-4-(2',4'-dichlorophenoxy)-6-(diethoxyphosphinyl)-1,3,5-triazine

Part A. Preparation of 2,4-dichloro-6-(diethoxyphosphinyl)-1,3,5-triazine

Into a stirred solution containing 36.9 grams (0.02 mole) of cyanuric chloride in 150 milliliters of toluene was added 33.2 grams (0.02 mole) of triethyl phosphite in small portions. The exothermic reaction was controlled by cooling in an ice bath until it ceased. The reaction mixture was stirred and heated for about 18 hours at a temperature of 60°C-90°C. Toluene was removed under reduced pressure and the residue extracted with hexane. After filtering through Celite, the crude product of 2,4-dichloro-6-(diethoxyphosphinyl)-1,3,5-triazine showed the following NMR spectrum (CFC1<sub>3</sub>):  $\delta$  1.15-1.65 ppm (3H, t, CH<sub>3</sub>), 4.16-4.75 (2H, pentet, CH<sub>2</sub>). This product was used in Part B without purification.

Part B. Preparation of 2-chloro-4-(2',4'-dichlorophenoxy)-6-(diethoxyphosphinyl)-1,3,5-triazine

A 10 gram (0.035 mole) portion of 2,4-dichloro-6-(diethoxyphosphinyl)-1,3,5-triazine prepared in Part A was dissolved in 50 milliliters

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of acetone and the resulting solution was added over a period of 15 minutes to a stirred mixture of 102 grams of ice and 54 milliliters of water. To this stirred suspension was added a solution containing 5.7 grams (0.035 mole) of 2,4-dichlorophenol in 18 milliliters of 8% aqueous sodium hydroxide. This mixture was stirred at 0-5°C for 1 hour and then at room temperature for an additional 1 hour. The aqueous layer was decanted away and the organic residue taken up in ether and water-washed, dried, filtered and the solvent evaporated to give 9.1 grams (0.02 mole) of 2-chloro-4-(2',4'-dichlorophenoxy)-6-(diethoxyphosphinyl)-1,3,5-triazine as an oily residue product. Elemental analysis of the product indicated the following:

Analysis:  $C_{13}H_{13}Cl_3N_3O_4P$   
Calculated: C, 37.84; H, 3.18; P, 7.51;  
Cl, 25.78  
Found: C, 38.93; H, 3.43; P, 7.37; Cl,  
25.32

This compound is referred to hereinafter as Compound 90.

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Example XXXI

Preparation of 2,4-dichloro-6-  
(2'-carbomethoxyphenylsulfonylamino)  
-1,3,5-triazine

A mixture of 5.7 grams (0.03 mole) of cyanuric chloride and 7.11 grams (0.03 mole) of the sodium salt of 2-carbomethoxybenzenesulfonamide in 150 milliliters of toluene was stirred at room temperature for a period of 20 minutes. The mixture was then heated to 80°C for 3 hours, filtered hot and the filtrate diluted with hexane and cooled. A white solid precipitated and was collected by suction and dried to give 3.0 grams (0.008 mole) of 2,4-dichloro-6-(2'-carbomethoxyphenylsulfonylamino)-1,3,5-triazine having a melting point of 212°C-215°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{11}H_8Cl_2N_4O_4S$   
Calculated: C, 36.38; H, 2.22; N, 15.42  
Found: C, 38.36; H, 1.63; N, 15.42

This compound is referred to hereinafter as Compound 91.

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Example XXXIIPreparation of 2-(2',4'-dichloro-alpha-methylbenzyloxy)-4,6-dichloro-1,3,5-triazine

Into a solution containing 7.4 grams (0.04 mole) of cyanuric chloride in 50 milliliters of acetone under a nitrogen atmosphere and cooled to 0°C was added dropwise a mixture of 7.6 grams (0.04 mole) of 2,4-dichloro-alpha-methylbenzyl alcohol and 4.3 grams (0.04 mole) of 2,6-lutidine and 25 milliliters of acetone. The resulting dark red reaction mixture was stirred at 0°C for 30 minutes during which time a white precipitate formed. Stirring at room temperature was continued for 2 days. The precipitate was then separated by filtration and the filtrate concentrated under reduced pressure. The unreacted cyanuric chloride was distilled out using a Kugelrohr apparatus (.25 mmHg, 50-70°C). The dark residue was then chromatographed on silica gel employing a 9:1 hexane - EtOAc eluent. This furnished 5.0 grams of an orange-yellow oil which was distilled using a Kugelrohr apparatus and a diffusion pump ( $10^{-4}$  mm Hg; 120°C) to yield 2.0 grams of a colorless solid. Recrystallization from hexane gave 1.4 grams (0.004 mole) of 2-(2',4'-dichloro-alpha-methylbenzyloxy)-4,6-dichloro-1,3,5-triazine as colorless needles having a melting point of 97.5°C-99.5°C. Elemental analysis of the product indicated the following:

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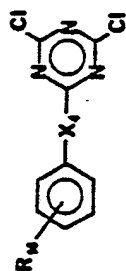
Analysis:  $C_{11}H_7Cl_4N_3O$   
Calculated: C, 38.97; H, 2.08; N, 12.40  
Found: C, 39.02; H, 1.82; N, 12.58

This compound is referred to hereinafter as Compound 92.

Example XXXIII

In a manner similar to that employed in Example XXXII, other compounds were prepared. The structure and analytical data for Compounds 93 through 95, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table E below.

TABLE E  
Representative Heterocyclic Nitrogen - Containing Compounds



Compound No.	Substituents		Elemental Analysis						Melting Point (°C)
	R <sub>16</sub>	X <sub>4</sub>	Calculated			Found			
			C	H	N	C	H	N	
93	2,4-Cl <sub>2</sub>	-CH <sub>2</sub> O-	36.96	1.55	12.93	37.10	1.61	12.77	99.0-103.5
94	2,4-Cl <sub>2</sub>	-CH-O-   CN	37.75	1.15	16.01	38.06	1.34	16.19	96.0-98.5
95	H	-CH-O-   CF <sub>3</sub>	40.77	1.87	12.97	40.90	2.04	12.76	68.0-70.0

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Example XXXIVPreparation of 2,4-dichlorobenzaldehyde O-  
(4,6-dichloro-1,3,5-triazin-2-yl)oximePart A. Preparation of 2,4-dichlorobenzaldehyde  
oxime

Into a solution containing 8.8 grams (0.13 mole) of hydroxylamine hydrochloride in 20 milliliters of water cooled to a temperature of 0°C was added 10.6 grams (0.13 mole) of sodium bicarbonate and a solution of 14.7 grams (0.08 moles) of 2,4-dichlorobenzaldehyde in 50 milliliters of ethanol. Stirring at room temperature and under nitrogen pressure was continued for 3 1/2 hours. The reaction mixture was then diluted with 150 milliliters of water and extracted with  $\text{CH}_2\text{Cl}_2$  (3 x 100 milliliters). The combined organic layers were dried over  $\text{MgSO}_4$  and concentrated under reduced pressure to yield 15.7 grams of a colorless solid. Chromatography on silica gel using dichloromethane as the eluent furnished 14.2 grams (0.07 mole) of 2,4-dichlorobenzaldehyde oxime as a colorless solid. The NMR spectrum of this material indicated the following: NMR ( $\text{CDCl}_3$ )  $\delta$  7.21 (1H, dd, J=9.2Hz), 7.40 (1H, d, J=2Hz), 7.75 (1H, d, J=9Hz), 8.09 (1H, s), 8.49 (1H, s) ppm.

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Part B. Preparation of 2,4-dichlorobenzaldehyde  
O-(4,6-dichloro-1,3,5 triazin-2-yl)oxime

2,4-Dichlorobenzaldehyde oxime prepared in Part A was reacted with cyanuric chloride using a procedure similar to that described in Example XXXII above. The reaction mixture was filtered to remove the precipitate and the filtrate was poured onto ice causing a yellow solid to form. The solid was separated and recrystallized from acetone-water to yield 2.1 grams (0.006 mole) of 2,4-dichlorobenzaldehyde O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime as pale yellow needles having a melting point of 124°C-124.5°C. Elemental analysis of the product indicated the following:

Analysis:	C <sub>10</sub> H <sub>4</sub> Cl <sub>4</sub> N <sub>4</sub> O
Calculated:	C, 35.54; H, 1.19; N, 16.58
Found:	C, 35.72; H, 1.35; N, 16.74

This compound is referred to hereinafter as Compound 96.

Example XXXV

Preparation of acetophenone O-(4,6-  
dichloro-1,3,5-triazin-2-yl)oxime

Acetophenone oxime and cyanuric chloride were reacted according to the procedure of Example XXXIV to give acetophenone O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime having a melting point of



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123°C-125°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{11}H_8Cl_2N_4O$   
Calculated: C, 46.67; H, 2.85; N, 19.79  
Found: C, 47.10; H, 2.80; N, 19.77

The compound is referred to hereinafter as Compound 97.

Example XXXVI

Preparation of 2,6-dichlorobenzaldehyde  
O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime

Into 300 milliliters of ice cold acetone was added 18.9 grams (0.1 mole) of 2,6-dichlorobenzaldoxime and 18.4 grams (0.1 mole) of cyanuric chloride. The pH value of the resulting solution was maintained at 6 by addition of 5% sodium bicarbonate solution. After stirring for 3 hours and keeping the pH at 6, crystals precipitated and were collected by suction filtration, washed three times with 100 milliliters of 20% aqueous acetone and dried in a vacuum oven for about 18 hours at 60°C to give 4.92 grams (0.02 mole) of 2,6-dichloro-benzaldehyde O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime having a melting point of 134.9°C-135.9°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_{10}H_4Cl_4N_4O$   
Calculated: C, 35.54; H, 1.19; N, 16.58  
Found: C, 35.78; H, 1.04; N, 16.40

This compound is referred to hereinafter as Compound 98.

Example XXXVII

Preparation of N-(2,4-dichlorophenyl)-N'-(4,6-dichloro-1,3,5-triazin-2-yl)hydrazine

A 4.3 gram (0.02 mole) portion of 2,4-dichlorophenylhydrazine was treated with 5.64 grams (0.03 mole) of cyanuric chloride in the presence of 3.11 grams (0.03 mole) of 2,6-lutidine in 125 milliliters of  $CH_2Cl_2$  in a manner similar to that employed in Example XXXII. After stirring for about 18 hours at room temperature, the reaction mixture was concentrated under reduced pressure and the residue recrystallized from  $CHCl_3$  to give 3.4 grams (0.01 mole) of N-(2,4-dichlorophenyl)-N'-(4,6-dichloro-1,3,5-triazin-2-yl) hydrazine as colorless needles having a melting point of 185.0°C-192.0°C (dec.). Elemental analysis of the product indicated the following:

Analysis:  $C_9H_5Cl_4N_5$   
Calculated: C, 33.26; H, 1.55; N, 21.55  
Found: C, 32.88; H, 1.60; N, 20.74

This compound is referred to hereinafter as Compound 99.

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Example XXXVIII

Preparation of N-(2,4-dichlorophenyl)  
-N-(4,6-dichloro-1,3,5-triazin-2-yl)  
methanesulfonamide

Part A. Preparation of 2,4-dichlorophenyl (methane-  
sulfonamide)

Into a magnetically stirred solution containing 13.5 grams (0.08 mole) of 2,4-dichloroaniline, 10.1 grams (0.1 mole) of triethylamine and 80 milliliters of dry tetrahydrofuran was added dropwise a solution containing 11.5 grams (0.1 mole) of methanesulfonyl chloride in 10 milliliters of tetrahydrofuran. A white precipitate separated as the addition proceeded. Stirring at room temperature was continued for about 16 hours and the mixture was then heated to reflux for 4 hours. The product was isolated by cooling, filtering to remove the precipitate and concentrating under reduced pressure to give 21.6 grams of a yellow solid. Chromatography on silica gel using a 9:1 toluene-ethyl acetate eluent furnished 1.5 grams (0.006 mole) of 2,4-dichlorophenyl (methanesulfonamide) as a yellowish solid. NMR analysis of the product indicated the following:

NMR (CDCl<sub>3</sub>)  $\delta$  3.10 (3H,s), 7.0 (1H,bs), 7.37 (1H,dd,J:2.9 Hz), 7.55 (1H,d,J:2Hz), 7.71 (1H,d,J:9Hz) ppm.

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Part B. Preparation of N-(2,4-dichlorophenyl)-N-(4,6-dichloro-1,3,5-triazin-2-yl) methanesulfonamide

Using a procedure similar to that employed in Example XXXVII, 1.15 grams (0.006 mole) of cyanuric chloride was treated with 1.5 grams (0.006 mole) of 2,4-dichlorophenylmethanesulfonamide and 670 milligrams (0.006 mole) of 2,6-lutidine. A colorless precipitate was separated by filtration and the filtrate was concentrated under reduced pressure to yield 2.8 grams of a yellow solid. This was flash chromatographed on silica gel employing a 3:1 hexane-ethyl acetate eluent to give 1.6 grams of a yellow solid. Recrystallization from toluene-hexane furnished 1.0 gram (0.003 mole) of N-(2,4-dichlorophenyl)-N-(4,6-dichloro-1,3,5-triazin-2-yl)methanesulfonamide as a yellow solid having a melting point of 145°C-157°C. 200 milligrams of additional yellow needles were obtained having a melting point of 154.5°C-157°C. NMR analysis of the product indicated the following:

NMR (CDCl<sub>3</sub>):  $\delta$  3.74 (3H,s), 7.10-7.68 (3H,m) ppm.

IR (CHCl<sub>3</sub>) 1540, 1590 cm<sup>-1</sup>

<sup>13</sup>C NMR (CDCl<sub>3</sub>)  $\delta$  171.60, 165.42, 136.98, 134.00, 133.08, 130.97, 130.51, 128.64, 43.50 ppm.

This compound is referred to hereinafter as Compound 100.

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Example XXXIXPreparation of 2-benzyloxy-4,6-dichloro-1,3,5-triazine

Into a magnetically stirred solution containing 4.22 grams (0.04 mole) of benzyl alcohol in 15 milliliters of acetone cooled to a temperature of 0-5°C was added dropwise 4.18 grams (0.04 mole) of 2,6-lutidine followed by a solution containing 7.2 grams (0.04 mole) of cyanuric chloride in 185 milliliters of acetone. After completing the feed, the reaction mixture was stirred for about 1 hour at 0°C and then warmed to room temperature. On reaching about 20°C, a precipitate of lutidine hydrochloride separated and was filtered off. The filtrate was poured onto ice causing the crude product to precipitate. This crude product was water-washed and dried to give 5.79 grams of material. Two recrystallizations from hexane gave 0.41 gram (0.002 mole) of 2-benzyloxy-4,6-dichloro-1,3,5-triazine having a melting point of 78°C-81.5°C. NMR analysis of the product indicated the following: NMR (CDCl<sub>3</sub>):  $\delta$  5.55 ppm (2H, s, CH<sub>2</sub>), 7.46 (5H, s, aromatic). This compound is referred to hereinafter as Compound 101.

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Example XLPreparation of 2-(2',4'-dichlorobenzyl)  
-4,6-dichloro-1,3,5-triazine

A 1.2 gram (0.05 mole) portion of magnesium turnings and 20 milliliters of ether were placed in a 100 milliliter 3-necked round-bottom flask under a nitrogen atmosphere. Two drops of a solution containing 9.7 grams (0.05 moles) of 2,4-dichlorobenzyl chloride in 15 milliliters of ether were added to initiate the reaction. The remaining portion of this solution was then added rapidly as to cause vigorous refluxing.

The Grignard reagent prepared above was added dropwise to a mixture of 9.2 grams (0.05 moles) of cyanuric chloride and 125 milliliters of ether cooled to a temperature of 3°C. An exotherm to 7°C and the formation of a white precipitate were observed as the addition proceeded. Stirring was continued at room temperature for about 16 hours and the resulting heterogenous mixture was filtered to remove the magnesium salt. The filtrate was washed with water and the organic phase dried over  $\text{MgSO}_4$  and concentrated under reduced pressure to give 12.6 grams of a yellow solid. A 4.0 gram portion of this material was chromatographed on silica gel using a 9:1 hexane: EtOAc eluent furnishing 2.9 grams of product. Recrystallization from hexane provided 1.7 grams (0.005 mole) of 2-(2',4'-dichlorobenzyl)-4,6-dichloro-1,3,5-triazine as colorless needles having a melting point of 110°C-112.5°C. Elemental analysis of this product indicated the following:

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Analysis:  $C_{10}H_5Cl_4N_3$   
Calculated: C, 38.87; H, 1.63; N, 13.60  
Found: C, 38.71; H, 1.70; N, 13.51

This compound is referred to hereinafter as Compound 102.

Example XLI

Preparation of 2-(2',4'-dichlorophenyl)  
-4,6-dichloro-1,3,5-triazine

A Grignard reagent was prepared from 11.1 grams (0.04 mole) of 2,4-dichloriodobenzene in the same manner as described in Example XL. The reagent was added dropwise to a solution of 7.5 grams (0.04 mole) of cyanuric chloride in 75 milliliters of dry tetrahydrofuran cooled to a temperature of 3°C. This caused an exotherm to 8°C and the formation of a white solid. The reaction mixture was stirred at room temperature for 7 hours and then heated to reflux for 3 days. The solid was separated by filtration and a black filtrate was concentrated under reduced pressure. The residue was partitioned between EtOAc and water and the organic phase dried over  $MgSO_4$  and concentrated to yield 14.9 grams of a black solid. Most of the unreacted cyanuric chloride was distilled out using a Kugelrohr apparatus. The residue was then chromatographed on silica gel using a 9:1 hexane: EtOAc eluent. This furnished 5.4 grams of a crude material. Sublimation (.05 mm Hg, 80°C-85°C) provided 2.0

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grams (0.007 mole) of 2-(2',4'-dichloro-phenyl)-4,6-dichloro-1,3,5-triazine as a colorless solid having a melting point of 111°C-115°C. Elemental analysis of the product indicated the following:

Analysis:	$C_9H_3Cl_4N_3$
Calculated:	C, 36.65; H, 1.03; N, 14.25
Found:	C, 34.22, H, 0.92; N, 13.20

This compound is referred to hereinafter as Compound 103.

#### Example XLII

##### Preparation of 2,4-dichloro-6-phenyl-1,3,5-triazine

A 1.40 gram portion (0.06 mole) of clean magnesium turnings was suspended in 4 milliliters of ethyl ether under a dry nitrogen atmosphere in a 50 milliliter reaction flask equipped with an additional funnel. Bromobenzene (9.48 grams, 0.06 mole) and approximately 21 milliliters of ether were charged to the flask's addition funnel and about 2 milliliters of this solution was added into the flask which was warmed to initiate the reaction. The remaining bromobenzene solution was added over about a one hour period giving a controlled rate of reflux. The mixture was stirred at room temperature for about 16 hours and then heated under reflux.



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The Grignard reagent prepared above was then transferred by syringe to a dry addition funnel attached to a stirred, nitrogen-purged dry flask containing a solution of 8.15 grams (0.04 mole) of cyanuric chloride in 75 milliliters benzene which was cooled to a temperature of 3°C. The Grignard reagent solution was fed dropwise with stirring and the resulting mixture allowed to warm to room temperature for a 4-day period. The reaction mixture was quenched with 50 milliliters of water and extracted with ether after which the organic layers were dried and evaporated free of solvent to give a solid. Crystallization from hexane gave a 4.91 gram (0.02 mole) first crop of product which was recrystallized from cyclohexane and then vacuum sublimed to give 2,4-dichloro-6-phenyl-1,3,5-triazine as a white crystalline material having a melting point of 117°C-118°C. Elemental analysis of the product indicated the following:

Analysis:	$C_9H_5Cl_2N_3$
Calculated:	C, 47.80; H, 2.23; N, 18.58
Found:	C, 47.50; H, 2.26; N, 18.49

This compound is referred to hereinafter as Compound 104.

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Example XLIIIPreparation of 2-(1-naphthyl)-  
4,6-dichloro-1,3,5-triazine

Into 0.66 gram (0.03 mole) of magnesium turnings was added a solution containing 3.77 milliliters (0.03 mole) of 1-bromonaphthalene in 50 milliliters of dry tetrahydrofuran. The resulting mixture was stirred at room temperature for 20 minutes, 150 milliliters of dry tetrahydrofuran was added and the mixture then stirred at room temperature under a nitrogen atmosphere for a period of 1 hour.

The Grignard reagent prepared above was transferred to an addition funnel and added dropwise to a solution containing 5.0 grams (0.03 mole) of cyanuric chloride in 300 milliliters of dry tetrahydrofuran at room temperature. After this mixture was stirred for a period of 3 hours, the solvent was evaporated to give a solid residue which was partitioned between 10% aqueous NaOH solution and Et<sub>2</sub>O. The Et<sub>2</sub>O layer was stirred over anhydrous Na<sub>2</sub>SO<sub>4</sub> and evaporated and the residue purified by preparative plate chromatography (silica gel) using 20% EtOAc in hexane to give 160 milligrams (0.0006 mole) of 2-(1-naphthyl)-4,6-dichloro-1,3,5-triazine as a yellow solid having a melting point of 166°C-167°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_{13}H_7Cl_2N_3$   
Calculated: C, 56.54; H, 2.56;  
Found: C, 55.27; H, 2.62

This compound is referred to hereinafter as Compound 105.

Example XLIV

Preparation of 2-(2-naphthyl)-  
4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XLIII except that ethyl ether was used as the solvent in place of tetrahydrofuran and the Grignard reagent was prepared from 2-bromo-naphthalene in refluxing ether over a 1.5 hour period, 2-(2-naphthyl)-4,6-dichloro-1,3,5-triazine was prepared having a melting point of 193°C-194°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{13}H_7Cl_2N_3$   
Calculated: C, 56.54; H, 2.56; N, 15.22;  
Cl, 25.68  
Found: C, 54.48; H, 2.63; N, 14.54;  
Cl, 27.98

This compound is referred to hereinafter as Compound 106.

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Example XLVPreparation of 2-benzyl-4,6-dichloro-1,3,5-triazine

A Grignard reagent prepared from 1.40 grams (0.06 mole) of magnesium and 0.91 gram (0.09 mole) of benzyl chloride was reacted with 8.15 grams (0.04 mole) of cyanuric chloride in a manner similar to that employed in Example XLII. The crude product (2.70 grams) was vacuum sublimed and then resublimed to give 0.99 gram (0.004 mole) of pure 2-benzyl-4,6-dichloro-1,3,5-triazine having a melting point of 82°C-85°C. Elemental analysis of the product indicated the following:

Analysis:	$C_{10}H_7Cl_2N_3$
Calculated:	C, 50.02; H, 2.94; N, 17.49
Found:	C, 49.90; H, 2.85; N, 17.57

The compound is referred to hereinafter as Compound 107.

Example XLVIPreparation of 2-(2',4'-dichlorobenzylthio)-4,6-dichloro-1,3,5-triazinePart A. Preparation of 2,4-dichlorobenzyl mercaptan

A mixture of 4.8 grams (0.06 mole) of thiourea, 12.2 grams (0.06 mole) of 2,4-dichlorobenzyl chloride and 50 milliliters of ethanol was stirred and heated to reflux under a nitrogen

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atmosphere for 4 1/2 hours. The reaction mixture was then cooled and a solution of 6.25 grams (0.16 mole) of NaOH in 50 milliliters of water was added dropwise. After the addition was completed, the mixture was heated to reflux for 2 hours during which time it became yellow in color. Stirring at room temperature was continued for 2 days. The ethanol was then removed under reduced pressure and the aqueous residue was extracted with  $\text{CH}_2\text{Cl}_2$  (6 x 100 milliliters). The combined organic layers were dried over  $\text{MgSO}_4$  and concentrated to yield 12.1 grams (0.06 mole) of 2,4-dichlorobenzyl mercaptan as a tan colored liquid. NMR analysis of the product indicated the following: NMR ( $\text{CDCl}_3$ ):  $\delta$  1.90 (1H, t,  $J=8\text{Hz}$ ), 3.79 (2H, d,  $J=8\text{Hz}$ ), 7.18-7.33 (2H, m), 7.33-7.48 (1H, m) ppm.

Part B. Preparation of 2-(2',4'-dichlorobenzylthio)-4,6-dichloro-1,3,5-triazine

Into a solution containing 6.5 grams (0.03 mole) of cyanuric chloride in acetone was added 6.7 grams (0.03 mole) of 2,4-dichlorobenzyl mercaptan prepared in Part A. A procedure similar to that employed in Example XXXII was used to prepare the product. The crude product was chromatographed on silica gel using a 1:1 hexane-toluene eluent to furnish 2.0 grams of the pure product. Recrystallization provided 1.9 grams (0.006 mole) of 2-(2',4'-dichlorobenzylthio)-4,6-dichloro-1,3,5-triazine having a melting point of 55.5°C-58.5°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_{10}H_5Cl_4N_3S$   
Calculated: C, 35.22; H, 1.48; N, 12.32  
Found: C, 35.56; H, 1.62; N, 12.47

This compound is referred to hereinafter as Compound 108.

Example XLVII

Preparation of 6-chloro-2,4-bis-  
(2',4'-dichlorobenzylthio)-1,3,5-triazine

The early chromatographic fractions from Example XLVI contained 2.3 grams of a colorless solid which was recrystallized from hexane to give 2.2 grams (0.004 mole) of 2,4-bis-(2',4'-dichlorobenzylthio)-6-chloro-1,3,5-triazine having a melting point of 76.0°C-80.0°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{17}H_{10}Cl_5N_3S_2$   
Calculated: C, 41.03; H, 2.03; N, 8.44  
Found: C, 41.35; H, 2.25; N, 8.93

This compound is referred to hereinafter as Compound 109.

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Example XLVIIIPreparation of 2-(2',4'-dichlorophenethoxy)-  
4,6-dichloro-1,3,5-triazinePart A. Preparation of 2,4-dichlorophenethyl alcohol

A 124 milliliter portion of a 1 M solution of borane-tetrahydrofuran complex in tetrahydrofuran was placed in a 500 milliliter 3-necked round-bottom flask and cooled to a temperature of 0°C with an ice bath. A solution containing 12.7 grams (0.06 mole) of 2,4-dichlorophenylacetic acid in 100 milliliters of tetrahydrofuran was added dropwise at such a rate as to maintain the temperature below 5°C. Gas evolution was observed as the addition proceeded. After the addition was completed, the colorless mixture was heated to reflux for 1 hour and then stirred at room temperature for about 16 hours. The reaction mixture was then treated with 125 milliliters of methanol. The solvent was removed under reduced pressure and the residue was dissolved in ether and washed with 5% aqueous NaOH. The organic phase was dried over  $\text{MgSO}_4$  and concentrated to yield 12.7 grams (0.066 mole) of 2,4-dichlorophenethyl alcohol as a colorless oil. NMR analysis of the product indicated the following: NMR ( $\text{CDCl}_3$ ):  $\delta$  1.62 (1H, s), 2.98 (2H, t,  $J=7\text{Hz}$ ), 3.88 (2H, t,  $J=7\text{Hz}$ ), 7.10-7.48 (3H, m) ppm.

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Part B. Preparation of 2-(2',4'-dichlorophenethoxy)-  
4,6-dichloro-1,3,5-triazine

A solution containing 6.45 grams (0.04 mole) of cyanuric chloride in acetone was treated with 6.7 grams (0.04 mole) of 2,4-dichlorophenethyl alcohol prepared in Part A using a procedure similar to that employed in Example XXXII. The crude product was chromatographed on silica gel using a 1:1 toluene-hexane eluent. The material obtained was recrystallized from hexane to yield 2.2 grams (0.006 mole) of 2-(2',4'-dichlorophenethoxy)-4,6-dichloro-1,3,5-triazine as colorless needles having a melting point of 106.5°C-108°C. Elemental analysis of the product indicated the following:

Analysis:	$C_{11}H_7Cl_4N_3O$
Calculated:	C; 38.97; H, 2.08; N, 12.40
Found:	C, 39.14; H, 2.35; N, 12.54

This compound is referred to hereinafter as Compound 110.

Example XLIX

Preparation of N-(4,6-dichloro-1,3,5-  
triazin-2-yl)-2,4-dichlorobenzamide

Into a stirred mixture containing 2.2 grams (0.01 mole) of 2,4-dichlorobenzoyl chloride, 1.7 grams (0.01 mole) of 2-amino-4,6-dichlorotriazine and 80 milliliters of acetone cooled to a temperature of 0°C was added a solution containing



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400 milligrams of NaOH in 4 milliliters of water. The NaOH solution was added at such a rate as to maintain the temperature below 4°C. Stirring was continued for a period of 3 hours after the addition was complete. The reaction mixture was then poured onto ice and the resulting milky solution was extracted with dichloromethane (4 x 75 milliliters). The combined extracts were dried over  $\text{MgSO}_4$  and concentrated under reduced pressure to give 3.6 grams of a colorless solid. Flash chromatography using a 9:1 hexane-EtOAc eluent furnished 900 milligrams of a colorless solid. This material was then dissolved in  $\text{CH}_2\text{Cl}_2$  and washed with saturated aqueous  $\text{NaHCO}_3$ . The organic layer was dried over  $\text{MgSO}_4$  and concentrated on the rotovap. The residue was recrystallized from toluene-hexane to yield 300 milligrams (0.001 mole) of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2,4-dichlorobenzamide having a melting point of 162°C-166°C. Elemental analysis of the product indicated the following:

Analysis:	$\text{C}_{10}\text{H}_4\text{Cl}_4\text{N}_4\text{O}$
Calculated:	C, 35.54; H, 1.19; N, 16.58
Found:	C, 36.03; H, 1.54; N, 16.23

This compound is referred to hereinafter as Compound 111.

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Example LPreparation of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2,4-dichloroacetanilidePart A. Preparation of 2,4-dichloroacetanilide

Into a 100 milliliter 3-necked round bottom flask was added 20 milliliters (0.21 mole) of acetic anhydride under a nitrogen atmosphere and cooled to a temperature of 3°C with an ice bath. To this was added 13.5 grams (0.08 mole) of 2,4-dichloroaniline in small portions. The mixture was allowed to stir at room temperature for 17 hours. The colorless solid which formed was removed by filtration and dried in the vacuum oven to yield 16.5 grams (0.08 mole) of 2,4-dichloroacetanilide. NMR analysis of the product indicated the following: NMR (CDCl<sub>3</sub>):  $\delta$  2.22 (3H,s), 7.18 (1H, dd), 7.34 (1H,d), 7.40-7.78 (1H,bs), 8.28 (1H,d) ppm.

Part B. Preparation of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2,4-dichloroacetanilide

Using a procedure similar to that employed in Example XLIX, a mixture containing 6.0 grams (0.03 mole) of 2,4-dichloroacetanilide prepared in Part A, 5.5 grams (0.03 mole) of cyanuric chloride and 120 milliliters of acetone was treated with a solution containing 1.18 grams (0.03 mole) of NaOH in 12 milliliters of water. Work-up furnished 10.5 grams of a colorless oil which was chromatographed on silica gel using a 9:1 hexane-ethyl acetate eluent. This gave 8.0 grams of a yellowish oil

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which solidified on standing. Recrystallization from hexane furnished 6.4 grams (0.02 mole) of colorless prisms of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2,4-dichloroacetanilide having a melting point of 106°C-108.5°C. NMR analysis of the product indicated the following: NMR (CDCl<sub>3</sub>):  $\delta$  2.82 (3H,s), 7.18 (1H,d,J=9Hz), 7.45 (1H,dd,J=2,9Hz), 7.6 (1H,d,J=2Hz) ppm.

This product is referred to hereinafter as Compound 112.

#### Example LI

##### Preparation of 2,4,-dichloro-6-phenylethynyl -1,3,5-triazine

Into ethylmagnesium bromide (49 milliliters of a 2 M solution in tetrahydrofuran, 0.1 mole) was added phenylacetylene (10 grams, 0.1 mole) in tetrahydrofuran (50 milliliters). Cyanuric chloride (12 grams, 0.07 mole) in benzene (65 milliliters) was added dropwise maintaining the reaction temperature below 25°C. After six hours of stirring the solvent was evaporated and the residue extracted with ether. The solvent was evaporated and the residue triturated with ether to afford 1.5 grams (0.006 mole) of 2,4-dichloro-6-phenylethynyl -1,3,5-triazine as a yellow solid having a melting point of 125°C-131°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_{11}H_5ClN_3$   
Calculated: C, 52.83; H, 2.02; N, 16.80  
Found: C, 53.37; H, 2.28; N, 16.25

This compound is referred to hereinafter as Compound 113.

Example LII

Preparation of 2-chloro-4-(phenylethynyl)-6-(2',2',2'-trifluoroethoxy)-1,3,5-triazine and 2,4-bis-(2',2',2'-trifluoroethoxy)-6-(phenylethynyl)-1,3,5-triazine

In a manner similar to that employed in Examples XXVIII and XXIX, 2, 4-dichloro-6-phenylethynyl-1,3,5-triazine was reacted with 2,2,2-trifluoroethanol to give 2-chloro-4-(phenylethynyl)-6-(2',2',2'-trifluoroethoxy)-1,3,5-triazine having a melting point of 48°C-51°C and also 2,4-bis-(2',2',2'-trifluoroethoxy)-6-(phenylethynyl)-1,3,5-triazine having a melting point of 68°C-72°C. Elemental analysis of the two products indicated the following:

2-chloro-4-(phenylethynyl)-6-(2',2',2'-trifluoroethoxy)-1,3,5-triazine

Analysis:  $C_{13}H_7ClF_3N_3O$   
Calculated: C, 49.78; H, 2.25; F, 18.17;  
Found: C, 50.98; H, 2.42; F, 17.11

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This compound is referred to hereinafter as Compound 114.

2,4-bis-(2',2',2'-trifluoroethoxy)-6-(phenylethynyl)-1,3,5-triazine

Analysis:  $C_{15}H_9F_6N_3O_2$   
Calculated: C, 47.76; H, 2.40; N, 11.14;  
F, 30.22  
Found: C, 48.42; H, 2.32; N, 11.26;  
F, 29.33

This compound is referred to hereinafter as Compound 115.

Example LIII

Preparation of 2-[4-(phenylazo)phenoxy]-4,6-dichloro-1,3,5-triazine

Into a 250 milliliter 3-neck round bottom flask equipped with a thermometer, addition funnel and nitrogen inlet was added cyanuric chloride (4.67 grams, 0.03 mole) dissolved in 30 milliliters of acetone and cooled to a temperature of 0-5°C in an ice bath. The addition funnel was charged with a solution containing 4-phenylazophenol (5.0 grams, 0.03 mole) and 2,6-lutidine (2.91 milliliters, 0.03 mole) in 30 milliliters of acetone, and this mixture was added dropwise maintaining the reaction temperature between 0°C and 5°C. After the addition was complete, the reaction was stirred at room

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temperature for 16 hours, filtered through a Celite pad, and ice-water (140 milliliters) was added. The precipitate which formed was collected on a Buchner funnel. The precipitate was dissolved in EtOAc, washed with saturated  $\text{NaHCO}_3$  and water, dried ( $\text{MgSO}_4$ ) and concentrated. The crude product was recrystallized twice from hexane: $\text{CHCl}_3$  (2:1), to give 750 milligrams (0.002 mole) of 2-[4-(phenylazo)phenoxy]-4,6-dichloro-1,3,5-triazine having a melting point of 162.0°C-164.0°C. Elemental analysis of the product indicated the following:

Analysis:  $\text{C}_{15}\text{H}_9\text{Cl}_2\text{N}_3\text{O}$   
Calculated: C, 52.04; H, 2.62; N, 20.23  
Found: C, 52.37; H, 2.82; N, 20.20

This compound is referred hereinafter as Compound 116.

#### Example LIV

##### Preparation of 2,2'-[1,3-phenylenebis(oxy)]-bis[4,6-dichloro-1,3,5-triazine]

Into a 250 milliliter 3-neck round bottom flask equipped with a nitrogen inlet, thermometer, and addition funnel was added cyanuric chloride (13.46 grams, 0.07 mole) dissolved in 100 milliliters of acetone and cooled to a temperature of 0-5°C in an ice bath. Resorcinol (4.0 grams, 0.04 mole) and 2,6-lutidine (8.50 milliliters, 0.07 mole) dissolved in 100 milliliters of acetone were placed

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in the addition funnel. This solution was slowly added dropwise while maintaining the reaction temperature at 0-5°C. The reaction was then stirred at room temperature for 16 hours. At this time the precipitate was removed by filtration through a Celite pad. Addition of ice-water (140 milliliters) to the filtrate gave an oil which was extracted from the aqueous solution with EtOAc (2 x 150 milliliters). The combined organic layers were dried (MgSO<sub>4</sub>) and concentrated in vacuo. The crude product was purified by flash chromatography on silica (eluent 5% EtOAc/hexane) to give 2.80 grams (0.007 mole) of the 2,2'-[1,3-phenylenebis(oxy)]-bis[4,6 dichloro-1,3,5-triazine] as a white solid having a melting point of 145°C-148°C. Elemental analysis of the product indicated the following:

Analysis:	$C_{12}H_4Cl_4N_6O_2$
Calculated:	C, 35.50; H, 0.99; N, 20.70
Found:	C, 35.07; H, 0.91; N, 20.40

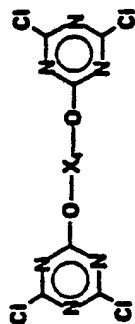
This compound is referred to hereinafter as Compound 117.

#### Example LV

In a manner similar to that employed in Example LIV, other compounds were prepared. The structures and analytical data for Compounds 118 through 121, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table F below.

TABLE F

## Representative Heterocyclic Nitrogen - Containing Compounds




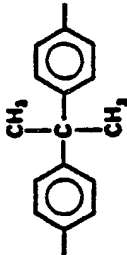
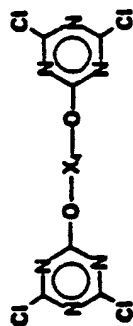
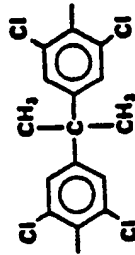

Compound No.	Substituents	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
118		35.50	0.99	20.70	36.04	1.19	19.94	253.0-257.0
119		48.11	2.69	16.03	48.06	2.67	15.92	115.0-116.0



TABLE F (Cont.)  
Representative Heterocyclic Nitrogen - Containing Compounds



Compound No.	Substituents	Elemental Analysis							Melting Point (°C)
		Calculated			Found				
		C	H	N	C	H	N		
120		38.10	1.52	12.69	38.04	1.69	12.31	228.0-232.0	
121		42.05	1.57	16.35	42.26	2.00	16.65	161.0-163.0	

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Example LVIPreparation of bis-  
(4,6-dichloro-1,3,5-triazin-2-yl)amine

Into a 250 milliliter 3-neck round bottom flask equipped with a thermometer and addition funnel was added cyanuric chloride (2.78 grams, 0.02 mole) in 50 milliliters of acetone cooled to a temperature of 0-5°C. 2-Amino-4,6-dichloro-1,3,5-triazine (2.48 grams, 0.02 mole) was added and the reaction temperature was brought to 0-5°C. A cold solution of NaOH (0.6 gram, 0.02 mole) in 6 milliliters of water was slowly added dropwise over 20 minutes. The reaction mixture was then stirred at room temperature for 4 hours, and then poured into 250 milliliters of ice-water with 4.5 grams of  $\text{Na}_2\text{CO}_3$  dissolved in it. The solution was filtered to remove a solid precipitate (tris[4,6-dichloro-1,3,5-triazin-2-yl]amine) and the filtrate was acidified. A white precipitate was collected on a Buchner funnel. The resulting powdery crystals (1.51 grams) were sublimed over a 2 day period to give 0.97 gram (0.003 mole) of pure bis(4,6-dichloro-1,3,5-triazin-2-yl)amine having a melting point of 204.0°C-207.0°C. Elemental analysis of the product indicated the following:

Analysis:	$\text{C}_6\text{HCl}_4\text{N}_6$
Calculated:	C, 23.03; H, 0.32; N, 31.33
Found:	C, 22.67; H, 1.20; N, 30.67

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This compound is referred to hereinafter as Compound 122.

Example LVII

Preparation of N,N-bis(4,6-dichloro-1,3,5-triazin-2-yl)-4'-fluorobenzenamine

N,N-bis(4,6-dichloro-1,3,5-triazin-2-yl)-4'-fluorobenzenamine was obtained from Maybridge Chemical Company, Limited, Trevillet, Tintagel, Cornwall, United Kingdom, and recrystallized from toluene. The melting point was determined to be 231.0°C-233.0°C. Elemental analysis of the compound indicated the following:

Analysis:  $C_{12}H_4Cl_4FN_7$   
Calculated: C, 35.41; H, 0.99; N, 24.08  
Found: C, 34.41; H, 1.06; N, 23.82

This compound is referred to hereinafter as Compound 123.

Example LVIII

Preparation of N,N-bis(4,6-dichloro-1,3,5-triazin-2-yl)-3'-chloro-4'-fluorobenzenamine

N,N-bis(4,6-dichloro-1,3,5-triazin-2-yl)-3'-chloro-4'-fluorobenzenamine was obtained from Maybridge Chemical Company, Limited, Trevillet,

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Tintagel, Cornwall, United Kingdom, and recrystallized from toluene. The melting point was determined to be 228.5°C-229.5°C. Elemental analysis of the compound indicated the following:

Analysis:  $C_{12}H_3Cl_5FN_7$   
Calculated: C, 32.65; H, 0.68; N, 22.21  
Found: C, 32.21; H, 0.86; N, 21.65

This compound is referred to hereinafter as Compound 124.

#### Example LIX

##### Preparation of 2,2',4,4'-tetrachlorohydrazo- 1,3,5-triazine

Into a 100 milliliter 3-neck round bottom flask equipped with a mechanical stirrer, thermometer, addition funnel and nitrogen inlet was added cyanuric chloride (3.68 grams, 0.02 mole) in 20 milliliters of tetrahydrofuran which was stirred vigorously and cooled to a temperature of -15°C to -10°C. Hydrazine hydrate (1.90 grams, 55% hydrazine content, 0.03 mole) in 4 milliliters of water was slowly added via the addition funnel, maintaining the reaction temperature between -15°C to -10°C. After the addition was complete, the reaction was stirred at 0°C for 15 minutes. Ice-water (40 milliliters) was added and the aqueous solution was then extracted with EtOAc (2 x 100 milliliters) and

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the extracts dried ( $\text{MgSO}_4$ ) and concentrated in vacuo to give 2.92 grams (0.009 mole) of 2,2',4,4'-tetrachlorohydrazo-1,3,5-triazine as a fine white solid which started to decompose over  $250^\circ\text{C}$ . Elemental analysis of the product indicated the following:

Analysis:	$\text{C}_6\text{H}_2\text{Cl}_4\text{N}_8$
Calculated:	C, 21.97; H, 0.61; N, 34.17
Found:	C, 23.64; H, 1.34; N, 36.23

This compound is referred to hereinafter as Compound 125.

#### Example LX

##### Preparation of 2,2',4,4'-tetrachloroazo-1,3,5-triazine

Into a 250 milliliter 3-neck round bottom flask equipped with a septum, outlet to acid trap and stopper was added 2,2',4,4'-tetrachlorohydrazo-1,3,5-triazine (3.20 grams, 0.01 mole) and 100 milliliters of  $\text{CHCl}_3$ . Sodium bicarbonate (1.64 grams, 0.02 mole) dissolved in 50 milliliters of water was added. The two phase solution was slowly stirred so that the phases remained separate. A slow stream of  $\text{Cl}_2$  gas was then bubbled through the  $\text{CHCl}_3$  layer until the  $\text{CHCl}_3$  layer was homogeneous and deep red, i.e., about 75 minutes. At this time the  $\text{CHCl}_3$  layer was separated and

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washed with water, dried ( $\text{Na}_2\text{SO}_4$ ) and concentrated in vacuo to give orange crystals which were slurried in ether, cooled and filtered. The resulting pale orange solid was recrystallized from  $\text{CHCl}_3$  to give 2.1 grams (0.006 mole) of 2,2',4,4'-tetrachloroazo-1,3,5-triazine having a melting point of 186.0°C-190.0°C. Elemental analysis of the product indicated the following:

Analysis:	$\text{C}_6\text{Cl}_4\text{N}_3$
Calculated:	C, 22.11; H, 0.00; N, 34.38
Found:	C, 22.78; H, 0.28; N, 33.98

This compound is referred to hereinafter as Compound 126.

#### Example LXI

##### Preparation of 2,4-dichloro-6-(4'-formyl-2'-methoxyphenoxy)-1,3,5-triazine

Into a solution containing cyanuric chloride (5.0 grams, 0.03 mole) in acetone (140 milliliters) at 0°C was added dropwise a solution containing 2,6-lutidine (3.15 milliliters, 0.03 mole) and 4-hydroxy-3-methoxybenzaldehyde (4.125 grams, 0.03 mole) in acetone (25 milliliters) while maintaining the temperature below 5°C. After 2 hours of stirring, the reaction mixture was filtered, and the filtrate filtered through silica gel and washed with acetone to afford 650 milligrams

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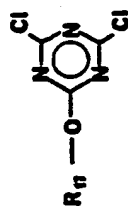
(0.002 mole) of 2,4-dichloro-6-(4'-formyl-2'-methoxy-phenoxy)-1,3,5-triazine as a white solid having a melting point of 156°C-157.5°C. NMR analysis of the product indicated the following: <sup>1</sup>H NMR(CDCl<sub>3</sub>): δ 3.8(s,3H); 7.2-7.7(m,3H); 10.05(s,1H) ppm.


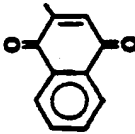
This compound is referred to hereinafter as Compound 127.

#### Example LXII

In a manner similar to that employed in Example LXI, other compounds were prepared. The structures and analytical data for Compounds 128 through 131, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table G below.

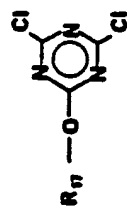
TABLE G

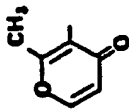
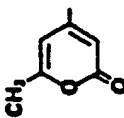
Representative Heterocyclic Nitrogen - Containing Compounds

Compound No.	Substituents	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
128		33.68	1.26	13.09	33.61	1.33	13.03	88-91
129		48.47	1.56	13.05	49.58	1.93	12.49	152-162



**TABLE 6 (Cont.)**  
**Representative Heterocyclic Nitrogen - Containing Compounds**



Compound No.	Substituents	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
130		39.44	1.84	15.33	35.36	1.65	16.78	126-135
131		39.44	1.84	15.33	39.93	1.91	14.63	177-180

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Example LXIIIPreparation of 2,4-dichloro-6-  
(5'-methylisoxazolyl-3'-amino)-1,3,5-triazine

Into a solution containing cyanuric chloride (5.0 grams, 0.03 mole) in acetone (100 milliliters) at a temperature of 0°C was added dropwise a solution containing 2,6-lutidine (3.15 milliliters, 0.03 mole) and 3-amino-5-methylisoxazole (2.66 grams, 0.03 mole) in acetone (50 milliliters) while maintaining the temperature below 5°C. After 2 hours of stirring, the reaction mixture was warmed to room temperature and then poured onto 200 milliliters of ice-water. The mixture was filtered, the solid dried and recrystallized from chloroform to afford 800 milligrams (0.003 mole) of 2,4-dichloro-6-(5'-methylisoxazolyl-3'-amino)-1,3,5-triazine as a solid having a melting point of 128°C-132°C. Elemental analysis of the product indicated the following:

Analysis:	$C_7H_5Cl_2N_5O$
Calculated:	C, 34.17; H, 2.05; N, 28.06
Found:	C, 34.24; H, 2.11; N, 28.15

This compound is referred to hereinafter as Compound 132.

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Example LXIVPreparation of 2,4-dichloro-6-  
(2-pyridinylamino)-1,3,5-triazine

Into a solution containing cyanuric chloride (18.4 grams, 0.1 mole) in acetone (140 milliliters) and crushed ice-water (200 milliliters) was added dropwise 2-aminopyridine (9.4 grams, 0.1 mole) in acetone (68 milliliters) while maintaining the reaction temperature below 5°C. Sodium hydroxide (50 milliliters of a 2N solution, 0.1 mole) was then added keeping the temperature below 5°C and the pH below 8.0. The reaction mixture was filtered and chromatographed on silica gel to afford 590 milligrams (0.002 mole) of 2,4-dichloro-6-(2-pyridinylamino)-1,3,5-triazine as an orange solid having a melting point of 170°C-172°C. Elemental analysis of the product indicated the following:

Analysis:	$C_8H_5Cl_2N_5$
Calculated:	C, 39.69; H, 2.08; N, 28.93
Found:	C, 34.08; H, 1.47; N, 27.92

This compound is referred to hereinafter as Compound 133.

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Example LXVPreparation of 2-benzoxazolylamino-  
4,6-dichloro-1,3,5-triazine

Into a mixture containing 2-aminobenzoxazole (1.0 gram, 0.007 mole) and cyanuric chloride (1.38 grams, 0.007 mole) in acetone (12 milliliters) at a temperature of 0°C was added 5% sodium hydroxide solution (34 milliliters) at such a rate as to maintain the temperature of the reaction mixture below 10°C and to maintain the pH between 6.5 and 7.0. After the addition was completed, the reaction mixture was filtered and the solid (0.75 gram) recrystallized from chloroform to afford 100 milligrams (0.003 mole) of 2-benzoxazolylamino-4,6-dichloro-1,3,5-triazine as a white solid having a melting point greater than 250°C. Elemental analysis of the product indicated the following:

Analysis:	$C_{10}H_5Cl_2N_5O$
Calculated:	C, 42.58; H, 1.79; N, 24.83
Found:	C, 41.68; H, 1.78; N, 23.58

This compound is referred to hereinafter as Compound 134.

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Example LXVIPreparation of 2,4-dichloro-6-(4'-quinazolinioxy)-  
-1,3,5-triazine

Into a mixture containing 4-hydroxy-quinazoline (5 grams, 0.03 mole) and cyanuric chloride (6.3 grams, 0.03 mole) in acetone (110 milliliters) was added 2% sodium hydroxide solution at such a rate as to maintain the temperature of the reaction mixture below 10°C and the pH between 6.5 and 7.0. After the addition was completed, the reaction mixture was allowed to warm to room temperature and stirred for about 16 hours. The reaction mixture was filtered, the solid placed in a Soxhlet extractor and extracted with refluxing chloroform. Evaporation of the solvent and chromatography on silica gel afforded 100 milligrams (0.0003 mole) of 2,4-dichloro-6-(4'-quinazolinioxy)-1,3,5-triazine as a solid having a melting point greater than 250°C. NMR analysis of the product indicated the following:

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 7.2-8.2 ppm (5H, m), 8.5 ppm (1H, s)

This compound is referred to hereinafter as Compound 135.

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Example LXVIIPreparation of 2-(2-carbazolyloxy)-  
4,6-dichloro-1,3,5-triazine

Into a mixture containing 2-hydroxycarbazole (3 grams, 0.02 mole) and cyanuric chloride (3 grams, 0.02 mole) in acetone (130 milliliters) at a temperature of 0°C was added 2% sodium hydroxide solution (130 milliliters) at such a rate as to maintain the temperature of the reaction mixture below 10°C and the pH between 6.5 and 7.0. After the addition was completed, the reaction mixture was stored in the refrigerator for about 16 hours and the solid product filtered and recrystallized from acetone. The solid was placed in a Soxhlet extractor, and extracted with refluxing chloroform for about 16 hours. Evaporation of the solvent afforded 3.75 grams (0.01 mole) of 2-(2-carbazolyloxy)-4,6-dichloro-1,3,5-triazine as a solid having a melting point of 249°C-256°C. Elemental analysis of the product indicated the following:

Analysis:	$C_{15}H_8Cl_2N_4O$
Calculated:	C, 54.40; H, 2.44; N, 16.92
Found:	C, 53.38; H, 2.51; N, 16.50

This compound is referred to hereinafter as Compound 136.

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Example LXVIIIPreparation of 2,4-dichloro-6-  
[4-(2,3-dimethyl-1-phenyl-3-pyrazolin-5-  
one-amino)]-1,3,5-triazine

Into a solution containing cyanuric chloride (18.4 grams, 0.1 mole) in acetone (200 milliliters) and crushed ice-water (200 milliliters) was added dropwise 4-aminoantipyrine (20.3 grams, 0.1 mole) in acetone (180 milliliters) while maintaining the reaction temperature below 5°C. Sodium hydroxide (50 milliliters of a 2N solution, 0.1 mole) was then added keeping the temperature below 5°C, and the pH below 8.0. The reaction mixture was filtered, the filtrate evaporated to remove acetone and the residue continuously extracted with ether for a period of about 16 hours. The solvent was evaporated to afford 860 milligrams (0.003 mole) of 2,4-dichloro-6-[4-(2,3-dimethyl-1-phenyl-3-pyrazolin-5-one-amino)]-1,3,5-triazine as a white solid having a melting point greater than 250°C. Elemental analysis of the product indicated the following:

Analysis:	C <sub>14</sub> H <sub>12</sub> Cl <sub>2</sub> N <sub>2</sub> O
Calculated:	C, 47.88; H, 3.45; N, 23.93
Found:	C, 46.57; H, 3.49; N, 23.05

This compound is referred to hereinafter as Compound 137.

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Example LXIXPreparation of 4,6-dichloro-2-  
(N-phthalimido)-1,3,5-triazine

Into a solution containing 20.8 grams (0.1 mole) of cyanuric chloride in 100 milliliters of acetone was added a suspension of 20.8 grams (0.1 mole) of potassium phthalimide in 200 milliliters of acetone with cooling to a temperature of 0-4°C. The resulting mixture was stirred at 0-4°C for 3 hours and then stirred at room temperature for about 16 hours. The mixture was filtered and the filtrate poured into ice-water with trituration to effect precipitation. The mixture was filtered and the solid dried in vacuo to give 17 grams of crude product. This crude product was recrystallized from  $\text{CH}_2\text{Cl}_2$ -hexane to give 4.5 grams (0.02 mole) of 4,6-dichloro-2-(N-phthalimido)-1,3,5-triazine having a melting point of 176°C-177°C Elemental analysis of the product indicated the following:

Analysis:	$\text{C}_{11}\text{H}_4\text{Cl}_2\text{N}_4\text{O}_2$
Calculated:	C, 44.90; H, 1.36
Found:	C, 45.05; H, 1.97

This compound is referred to hereinafter as Compound 138.



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Example LXXPreparation of 4,6-dichloro-2-(N-3,4,5,6-tetrachlorophthalimido)-1,3,5-triazine

Into a suspension containing 4.02 grams (0.04 mole) of 35% by weight KH in oil was added 100 milliliters of tetrahydrofuran and a solution containing 3,4,5,6-tetrachlorophthalimide (10.0 grams, 0.03 mole) in tetrahydrofuran at a temperature of 4°C. The mixture was stirred at room temperature for 30 minutes, cooled to 0°C and a solution containing 6.47 grams (0.04 mole) of cyanuric chloride in 150 milliliters of dry tetrahydrofuran was added. The mixture was stirred at room temperature for about 16 hours, filtered and the filtrate poured onto ice-water. The precipitate was filtered to give 20 grams of crude product. This material was extracted with hot  $\text{CH}_2\text{Cl}_2$ . The methylene chloride solution was cooled to room temperature and hexane added to crystallize the product. Filtration gave 700 milligrams (0.002 mole) of 4,6-dichloro-2-(N-3,4,5,6-tetrachlorophthalimido)-1,3,5-triazine as a white solid having a melting point of 298°C-300°C. IR analysis of the product indicated the following:

IR(KBr) 1745, 1510, 1400, 1370, 1300 and 1235  $\text{cm}^{-1}$ .

This compound is referred to hereinafter as Compound 139.

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Example LXXIPreparation of 2-(4',6'-dichloro-1',  
3',5'-triazin-2'-yl)-1,2-benzisothiazol-  
3(2H)one 1,1-dioxide

Into a solution containing 100 grams (0.054 mole) of cyanuric chloride in 200 milliliters of acetone was added a suspension containing 10 grams (0.054 mole) of saccharin in 100 milliliters of acetone. The mixture turned homogeneous after several minutes, and 5.5 milliliters (0.054 mole) of 2,6-lutidine were added followed by stirring at room temperature under a nitrogen atmosphere for about 16 hours. The suspension was then filtered, the filtrate evaporated, and the residue was partially crystallized from  $\text{CH}_2\text{Cl}_2$ -hexane. This solid was filtered and the filtrate evaporated to give a residue which was recrystallized from  $\text{CH}_2\text{Cl}_2$ -hexane to give 2.0 grams (0.006 mole) of 2-(4',6'-dichloro-1',3',5'-triazin-2'-yl)-1,2-benzisothiazol-3(2H)one 1,1-dioxide. Elemental analysis of the product indicated the following:

Analysis:	$\text{C}_{10}\text{H}_4\text{O}_3\text{Cl}_2\text{N}_4\text{S}$
Calculated:	C, 38.60; H, 1.30; N, 18.01; Cl, 22.79
Found:	C, 36.59; H, 1.43; N, 16.27; Cl, 20.71

This compound is referred to hereinafter as Compound 140.

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Example LXXIIPreparation of 2,4-dichloro-6-trimethylsilylethynyl-1,3,5-triazine

Ethylmagnesium bromide (35.4 milliliters of 2 M tetrahydrofuran solution) was added dropwise to a solution of trimethylsilylacetylene (14.4 milliliters, 0.1 mole) in tetrahydrofuran (80 milliliters) at a temperature of  $-60^{\circ}\text{C}$ . The solution was allowed to warm to room temperature, stirred for 2 hours and then heated at  $40^{\circ}\text{C}$  for 1 hour. The solution was cooled to room temperature and then added dropwise to a solution of cyanuric chloride (12 grams, 0.07 mole) in tetrahydrofuran (65 milliliters). After 1 hour at room temperature, the solvent was evaporated and the residue extracted with ether. The ether was evaporated and the residue chromatographed on silica gel to afford 1.2 grams (0.005 mole) of 2,4-dichloro-6-trimethylsilylethynyl-1,3,5-triazine as a brown oil. Elemental analysis of the product indicated the following:

Analysis:	$\text{C}_8\text{H}_9\text{Cl}_2\text{N}_3\text{Si}_1$
Calculated:	C, 39.03; H, 3.69; N, 17.07
Found:	C, 39.67; H, 3.90; N, 15.97

The compound is referred to hereinafter as Compound 141.

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Example LXXIIIPreparation of 2,4-dichloro-6-ethoxyethynyl-1,3,5-triazine

Into ethylmagnesium bromide (21.0 milliliters of a 2M solution in tetrahydrofuran) was added dropwise a solution of ethoxyacetylene (3.0 grams, 0.04 mole) in tetrahydrofuran (21 milliliters) at a temperature of 0°C. After the addition was complete, the reaction mixture was heated to 40°C for 1 hour, cooled to 0°C and then added dropwise to a solution of cyanuric chloride (7.9 grams, 0.04 mole) in tetrahydrofuran (21 milliliters). The reaction mixture was stirred for about 16 hours, the solvent evaporated, and the residue extracted with ether. The ether was evaporated and the residue chromatographed on silica gel to afford 1.5 grams (0.007 mole) of 2,4-dichloro-6-ethoxyethynyl-1,3,5-triazine as an orange oil. NMR analysis of the product indicated the following:  $^1\text{H}$  NMR( $\text{CDCl}_3$ ):  $\delta$  1.4(t, 3H); 4.55(q, 2H) ppm.

This compound is referred to hereinafter as Compound 142.

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Example LXXIVPreparation of 2,4-dichloro-6-methylsulfonamido-1,3,5-triazine

Into a mixture containing methanesulfonamide (9.5 grams, 0.1 mole) and sodium hydroxide (4 grams, 0.1 mole) in water (0.5 liter) at a temperature of 25°C was added a solution containing cyanuric chloride (18.4 grams, 0.1 mole) in acetone (100 milliliters). After the addition was completed, sodium hydroxide (4 grams, 0.1 mole) in water (25 milliliters) was added dropwise while maintaining the pH of the reaction mixture below 8.0. The reaction mixture was placed in the refrigerator for about 16 hours, warmed to room temperature and filtered to afford a white solid. Recrystallization from chloroform gave 400 milligrams (0.002 mole) of 2,4-dichloro-6-methylsulfonamido-1,3,5-triazine as a white solid having a melting point of 204°C-206°C. Elemental analysis of the product indicated the following:

Analysis:	$C_4H_4Cl_2N_4O_2S$
Calculated:	C, 19.76; H, 1.66; N, 23.05.
Found:	C, 19.48; H, 1.68; N, 22.44.

This compound is referred to hereinafter as Compound 143.

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Example LXXVPreparation of 2,4-dichloro-6-  
(1'-piperidinoamino)-1,3,5-triazine

Into a solution containing cyanuric chloride (5.0 grams, 0.03 mole) in acetone (120 milliliters) at a temperature of 0°C was added dropwise a solution containing 2,6-lutidine (3.15 milliliters, 0.03 mole) and N-aminopiperidine (2.7 grams, 0.03 mole) in acetone (21 milliliters) while maintaining the temperature below 5°C. After 2 hours of stirring, the reaction mixture was warmed to room temperature and stirred for 1 hour. The reaction mixture was then filtered and the filtrate evaporated. The residue was chromatographed on silica gel to afford 620 milligrams (0.002 mole) of 2,4-dichloro-6-(1'-piperidinoamino)-1,3,5-triazine as a yellow solid having a melting point of 114°C-117°C. Elemental analysis of the product indicated the following:

Analysis:  $C_8H_{11}Cl_2N_5$   
Calculated: C, 38.72; H, 4.47; N, 28.23.  
Found: C, 37.31; H, 4.51; N, 26.75.

This compound is referred to hereinafter as Compound 144.

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Example LXXVIPreparation of 2,4-bis-  
(dimethylamino)-6-chloro-1,3,5-triazine

Into a solution containing cyanuric chloride (92.2 grams, 0.5 mole) dissolved in acetone (350 milliliters) and cooled to a temperature of -30°C was added liquid dimethylamine (90 grams, 2.0 moles) while maintaining the reaction temperature below -20°C. After reaction mixture ceased stirring, the internal temperature rose to 5°C. The reaction mixture was then poured onto crushed ice (2 kilograms) and the acetone evaporated by blowing air over the surface while maintaining the mixture at 0°C. After filtration, the solid (124 grams) was recrystallized from pentane and chromatographed on silica gel to afford 400 milligrams (0.002 mole) of 2,4-bis(dimethylamino)-6-chloro-1,3,5-triazine as a yellow solid having a melting point of 62°C-64°C. Elemental analysis of the product indicated the following:

Analysis:	$C_7H_{12}ClN_5$
Calculated:	C, 41.69; H, 6.00; N, 34.73
Found:	C, 41.32; H, 5.94; N, 35.18

This compound is referred to hereinafter as Compound 145.

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Example LXXVIIPreparation of 2,4,-dichloro-6-  
dimethylamino-1,3,5-triazine

Into a solution containing cyanuric chloride (92.2 grams, 0.5 mole) dissolved in acetone (380 milliliters) and cooled to a temperature of  $-30^{\circ}\text{C}$  was added dropwise 40% aqueous dimethylamine (79 grams, 0.7 mole) while maintaining the reaction temperature below  $-20^{\circ}\text{C}$ . After addition was completed, the reaction mixture was stirred at  $-10^{\circ}\text{C}$  for 30 minutes. The reaction mixture was poured onto crushed ice (2 kilograms) and the acetone evaporated by blowing air over the surface while maintaining the mixture at  $0^{\circ}\text{C}$ . After filtration, the solid was recrystallized from pentane to afford 59.0 grams (0.3 mole) of 2,4-dichloro-6-dimethylamino-1,3,5-triazine as a white solid having a melting point of  $111.5^{\circ}\text{C}$ - $115.5^{\circ}\text{C}$ . Elemental analysis of the product indicated the following:

Analysis:	$\text{C}_5\text{H}_6\text{Cl}_2\text{N}_4$
Calculated:	C, 31.11; H, 3.13; N, 29.03
Found:	C, 31.06; H, 3.06; N, 29.46

This compound is referred to hereinafter as Compound 146.



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Example LXXVIIIPreparation of 2,4-dichloro-6-  
(1-morpholinyl)-1,3,5-triazine

Into a solution containing cyanuric chloride (18.4 grams, 0.1 mole) in acetone (120 milliliters) and crushed ice-water (200 milliliters) was added dropwise morpholine (17.4 grams, 0.1 mole) while maintaining the reaction temperature below 5°C. To this mixture was added a sodium hydroxide solution (25 milliliters of 2N solution) while keeping the temperature below 5°C and the pH below 8.0. The reaction mixture was filtered and the separated solid recrystallized from ether to afford 8.0 grams (0.03 mole) of 2,4-dichloro-6-(1-morpholinyl)-1,3,5-triazine as a white solid having a melting point of 154°C-157°C. Elemental analysis of the product indicated the following:

Analysis:  $C_7H_8Cl_2N_4O$ 

Calculated: C, 35.76; H, 3.43; N, 23.84

Found: C, 35.58; H, 3.60; N, 23.83

This compound is referred to hereinafter as Compound 147.

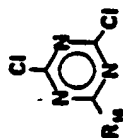
Example LXXIX



In a manner similar to that employed in Example LXXVIII, other compounds were prepared. The structures and analytical data for Compounds 148 and

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149, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table H below.

TABLE II  
Representative Heterocyclic Nitrogen - Containing Compounds



Compound No.	Substituents	Elemental Analysis								Melting Point (°C)
		Calculated				Found				
		C	H	N	W	C	H	N	W	
148		41.22	4.32	24.04		41.08	4.19		23.86	82-85
149		38.38	3.68	25.58		38.60	3.78		25.46	107-109

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Example LXXXPreparation of 2-bis(chloromethyl)  
amino-4,6-dichloro-1,3,5-triazine

2,4-Dichloro-6-dimethylamino-1,3,5-triazine (18.0 grams, 0.09 mole) prepared in Example LXXVII was heated to a temperature of 130°C, chlorine gas introduced and the solution irradiated with ultraviolet light for a period of 5 hours. The resulting residue was chromatographed on silica gel to afford 300 milligrams (0.001 mole) of 2-bis(chloromethyl)amino-4,6-dichloro-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis:	$C_5H_4Cl_4N_4$
Calculated:	C, 22.92; H, 1.54; N, 21.39
Found:	C, 23.10; H, 1.87; N, 21.93

This compound is referred to hereinafter as Compound 150.

Example LXXXIPreparation of 2,2'-[1,2-phenylenebis(oxy)]-  
bis[4,6-dichloro-1,3,5-triazine]

In a manner similar to that employed in Example LIV, cyanuric chloride was reacted with 1,2-dihydroxybenzene in the presence of 2,6-lutidine

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as an acid acceptor to give 2,2'-[1,2-phenylenebis (oxy)]-bis[4,6-dichloro-1,3,5-triazine] having a melting point of 154°C-156°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{12}H_4Cl_4N_6O_2$   
Calculated: C, 35.50; H, 0.99; N, 20.70  
Found: C, 35.60; H, 1.29; N, 20.68

This compound is referred to hereinafter as Compound 151.

#### Example LXXXII

##### Preparation of 2,4-dibromo-6-isopropoxy-1,3,5-triazine

###### Part A. Preparation of 2,4-dichloro-6-isopropoxy-1,3,5-triazine

Into a stirred solution containing 20.0 grams (0.108 mole) of cyanuric chloride in 150 milliliters of acetone was added 12.6 milliliters (0.12 mole) of 2,6-lutidine dropwise at temperature of -70°C. 2-Propanol (8.3 milliliters, 0.11 mole) was added and the resulting mixture stirred under a nitrogen atmosphere at room temperature for about 16 hours. The reaction mixture was then evaporated free of solvent and the residue partitioned between ethyl ether and water. The organic layer was dried (anhydrous  $Na_2SO_4$ ), evaporated and the residue distilled in vacuo to give 2.0 grams (0.01 mole) of

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2,4-dichloro-6-isopropoxy-1,3,5-triazine as an oil having a boiling point of 152°C- 155°C/42 millimeters Hg.

Part B. Preparation of 2,4-dibromo-6-isopropoxy-1,3,5-triazine

2,4-Dichloro-6-isopropoxy-1,3,5-triazine prepared in Part A was treated with gaseous hydrogen bromide in a methylene chloride solution at a temperature of 25°C by employing a procedure similar to that described in Example XIX to give 2,4,-dibromo-6-isopropoxy-1,3,5-triazine as an unstable solid. Elemental analysis of the product indicated the following:

Analysis:	$C_6H_7Br_2N_3O$
Calculated:	C, 24.24; H, 2.36; N, 14.14; Br, 53.87
Found:	C, 21.14; H, 2.83; N, 13.89; Br, 53.88

This compound is referred to hereinafter as Compound 152.

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Example LXXXIIIPreparation of 5-(3',5'-dichlorophenoxy)-  
3,6-dichloro-1,2,4-triazinePart A. Preparation of 3,5,6-trichloro-  
1,2,4-triazine

A mixture containing 6-azauracil (50 grams, 0.44 mole), bromine (49.8 milliliters, 1.0 mole), and water (625 milliliters) was stirred with a magnetic stirrer for 27 hours. The mixture was filtered to yield a white powder. Concentration of the filtrate gave additional product that was combined with the first. The white solid was recrystallized from water and dried to give 53.4 grams (0.33 mole) of 5-bromo-6-azauracil having a melting point of 234°C-237°C.

Into 14.4 grams (0.08 mole) of 5-bromo-6-azauracil prepared above in 299.5 milliliters (3.4 mole) of phosphorus oxychloride was added 30.0 grams (0.14 mole) of phosphorus pentachloride and 30 milliliters (0.19 mole) of N,N-diethylaniline. The mixture was magnetically stirred and heated under reflux for 2 hours and allowed to stand at room temperature for 24 hours. The excess solvent was removed under reduced pressure and the residue extracted with eight 200 milliliters portions of dry ether. The ether was removed and the residue distilled at 70°C/0.007 millimeters to give 8.77 grams (0.05 mole) of 3,5,6-trichloro-1,2,4-triazine having a melting point of 56°C-58°C.

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Part B. Preparation of 5-(3',5'-dichlorophenoxy)  
-3,6-dichloro-1,2,4-triazine

Into a solution containing 1.84 grams (0.01 mole) of 3,5,6-trichloro-1,2,4-triazine prepared in Part A in 50 milliliters of acetone was added, with cooling and stirring, 1.07 grams (0.01 mole) of 2,6-lutidine and 1.63 grams (0.01 mole) of 3,5-dichlorophenol dissolved in 10 milliliters of acetone at such a rate that the reaction temperature remained at 0-5°C. The reaction mixture was magnetically stirred for 2 hours and allowed to warm to room temperature. The precipitated 2,6-lutidine hydrochloride was filtered off and washed in 50 milliliters of acetone. The acetone solution was poured onto about 100 grams of ice and the product that precipitated was collected and washed with 20 milliliters of cold 10% aqueous NaOH and 10 milliliters of cold water. The solid was dried and crystallized from hexane to give 2.3 grams (0.007 mole) of 5-(3',5'-dichlorophenoxy)-3,6-dichloro-1,2,4-triazine as a white solid having a melting point of 130°C-132°C. Elemental analysis of the product indicated the following:

Analysis:  $C_9H_3Cl_4N_3O$

Calculated: C, 34.76; H, 0.97; N, 13.51

Found: C, 34.64; H, 0.93; N, 13.69

This compound is referred to hereinafter as Compound 153.

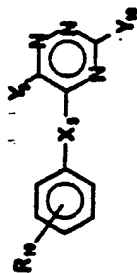


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Example LXXXIX

In a manner similar to that employed in Example LXXXVIII, other compounds were prepared. The structures and analytical data for Compounds 154 through 156, which compounds were used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table I below.

**TABLE I**  
**Representative Heterocyclic Nitrogen - Containing Compounds**



Compound No.	Substituents				Elemental Analysis						Melting Point (°C)	
	R <sub>19</sub>	X <sub>5</sub>	Y <sub>9</sub>	Y <sub>10</sub>	Calculated			Found				
					C	H	N	C	H	N		
154	4-ND <sub>2</sub>	0	Cl	Cl	37.66	1.40	19.52	37.71	1.74	19.63	169-172	
155	4-CN	0	Cl	Cl	44.97	1.51	20.98	44.88	1.67	21.14	149-152	
156	2,4-Cl <sub>2</sub>		NH	Cl	Cl	34.87	1.30	18.08	34.86	1.42	17.44	175-177

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Example XCPreparation of 5-(2',4'-dichlorophenoxy)-  
3,6-dichloro-1,2,4-triazine

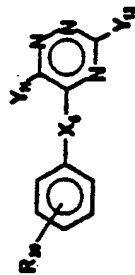
3,5,6-Trichloro-1,2,4-triazine and 2,4-dichlorophenol were reacted in an acetone solution employing quinaldine as the acid acceptor in a manner similar to that employed in Example III to give 3.0 grams (0.01 mole) of 5-(2',4'-dichlorophenoxy)-3,6-dichloro-1,2,4-triazine having a melting point of 90°C-93°C after recrystallization from hexane. Infrared analysis of the product indicated the following: IR (KBr) 3090, 1530, 1505, 1470, 1400, 1295, 1235, 1205, 1100, 1050, 985, 865, 830, 750  $\text{cm}^{-1}$ .

This compound is referred to hereinafter as Compound 157.

Example XCI

In a manner similar to that employed in Example XC, other compounds were prepared. The structure and analytical data for Compounds 158 through 160, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table J below.

TABLE 3  
Representative Heterocyclic Nitrogen - Containing Compounds



Compound No.	R20	Substituents					Elemental Analysis					Melting Point (°C)
		X6	Y11	Y12	Calculated		Found					
					C	H	C	H	N			
158(a)	4-CH3S-	O	Cl	Cl	41.68	2.45	41.80	2.65	14.58	14.78	123-125	
159	3,5-Cl2	S	Cl	Cl	33.05	0.92	33.52	0.95	12.85	12.47	114-117	
160	3-C6H5O-	NH	Cl	Cl	54.07	3.03	54.32	2.84	16.82	16.96	132-134	

(a) 2,6-Lutidine was employed as the acid acceptor in place of quinaldine.

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Example XCIIPreparation of 2,6-dichlorobenzaldehyde  
O-(3,6-dichloro-1,2,4-triazin-4-yl)oxime

In a manner similar to that employed in Example XXXVI, 3,5,6-trichloro-1,2,4-triazine was reacted with 2,6-dichlorobenzaldoxime to give 0.93 gram (0.003 mole) of 2,6-dichlorobenzaldehyde O-(3,6-dichloro-1,2,4-triazin-4-yl)oxime having a melting point of 103°C-105°C. Elemental analysis of the product indicated the following:

Analysis:	$C_{10}H_4Cl_4N_4O$
Calculated:	C, 35.54; H, 1.19; N, 16.58
Found:	C, 35.76; H, 1.60; N, 17.04

This compound is referred to hereinafter as Compound 161.

Example XCIIIPreparation of 3-chloro-6-  
(2',4'-dichlorophenoxy)pyridazine

A mixture containing 5.96 grams (0.04 mole) of 3,6-dichloropyridazine, 6.52 grams (0.04 mole) of 2,4-dichlorophenol, and 5.80 grams (0.04 mole) of  $K_2CO_3$  in 200 milliliters of acetone was heated on a steam bath for a period of 2 hours. The solvent was removed and the residue washed with 100

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milliliters of 10% aqueous NaOH and then 100 milliliters of water. The crude solid was crystallized from hexane to give a total of 1.6 grams (0.006 mole) of 3-chloro-6-(2',4'-dichlorophenoxy)pyridazine as a white solid having a melting point of 89°C-91°C. Elemental analysis of the product indicated the following:

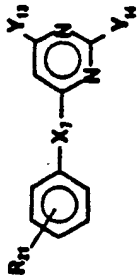
Analysis:	$C_{10}H_5Cl_3N_2O$
Calculated:	C, 43.59; H, 1.83; N, 10.17
Found:	C, 43.59; H, 1.91; N, 10.06

This compound is referred to hereinafter as Compound 162.

#### Example XCIV

In a manner similar to that employed in Example XCIII, other compounds were prepared. The structures and analytical data for Compound 163, which compound is used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table K below.

TABLE K  
Representative Heterocyclic Nitrogen - Containing Compounds



Compound No.	Substituents				Elemental Analysis						Melting Point (°C)
	R <sub>21</sub>	X <sub>7</sub>	Y <sub>13</sub>	Y <sub>14</sub>	Calculated			Found			
					C	H	N	C	H	N	
163	2,4-Cl <sub>2</sub>	0	CH <sub>3</sub>	Cl	45.63	2.44	9.67	45.43	2.66	9.70	69-91

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Example XCVPreparation of tris(4,6-dichloro-  
1,3,5-triazin-2-yl)amine

In the procedure employed in Example LVI for the preparation of bis(4,6-dichloro-1,3,5-triazin-2-yl)amine, a solid precipitate was isolated by filtration to give tris(4,6-dichloro-1,3,5-triazin-2-yl)amine as a by-product having a melting point of greater than 360°C (dec.). Elemental analysis of the product indicated the following:

Analysis:	$C_9Cl_6N_{10}$
Calculated:	C, 23.45; H, 0.00, N, 30.39
Found:	C, 21.85; H, 1.18; N, 33.65

This compound is referred to hereinafter as Compound 164.

Example XCVI

In a manner similar to that employed in Example XCIII, other compounds were prepared. The structures and analytical data for Compound 165, which compound is used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table L below.





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Example XCVIIPreparation of 3-chloro-6-  
(3'-chlorophenoxy)pyridazine

Into a solution containing 1.93 grams (0.015 mole) of 3-chlorophenol and 1.5 grams (0.005 mole) of tetrabutylammonium bromide in 24 milliliters of 1.25 N aqueous sodium hydroxide was added 2.23 grams (0.015 mole) of 3,6-dichloropyridazine dissolved in 50 milliliters of toluene. The mixture was heated to a temperature of 50°C and stirred for 3 hours. The organic layer was separated, washed with dilute NaOH solution and water, dried over  $\text{MgSO}_4$  and evaporated. The residue obtained was crystallized from hexane to give 1.55 grams (0.006 mole) of 3-chloro-6-(3'-chlorophenoxy)pyridazine as a white solid having a melting point of 85°C-88°C. Elemental analysis of the product indicated the following:

Analysis:	$\text{C}_{10}\text{H}_6\text{Cl}_2\text{N}_2\text{O}$
Calculated:	C, 49.82; H, 2.51; N, 11.62
Found:	C, 49.87; H, 2.48; N, 11.65

This compound is referred to hereinafter as Compound 166.

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Example XCVIIIPreparation of 4-(4'-nitrophenoxy)  
-2,5,6-trichloropyrimidine

In a manner similar to that employed in Example I, 2,4,5,6-tetrachloropyrimidine and 4-nitrophenol were reacted in acetone solution employing 2,6-lutidine as the acceptor to give 0.8 gram (0.002 mole) of 4-(4'-nitrophenoxy)-2,5,6-trichloropyrimidine having a melting point of 114°C-116°C following vacuum sublimation and two recrystallizations from hexane. Elemental analysis of the product indicated the following:

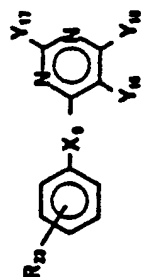
Analysis:	$C_{10}H_4Cl_3N_3O_3$
Calculated:	C, 37.47; H, 1.26; N, 13.11; Cl, 33.18
Found:	C, 36.89; H, 1.52; N, 13.00; Cl, 32.79

This compound is referred to hereinafter as Compound 167.

Example XCIX

In a manner similar to that employed in Example XCVIII, other compounds were prepared. The structures and analytical data for Compounds 168 and 169, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table M below.

**TABLE M**  
**Representative Heterocyclic Nitrogen - Containing Compounds**



Compound No.	Substituents					Elemental Analysis						Melting Point (°C)
	R <sub>23</sub>	X <sub>9</sub>	Y <sub>16</sub>	Y <sub>17</sub>	Y <sub>18</sub>	Calculated		Found		M		
						C	H	C	H			
168	3,5-Cl <sub>2</sub>	0	Cl	Cl	Cl	34.87	0.88	8.13	35.06	0.66	8.15	94-96
169	2,4-Cl <sub>2</sub>	0	Cl	Cl	Cl	34.87	0.88	8.13	35.14	1.04	8.29	108-112

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Example CPreparation of 2-(2',4'-dichlorophenoxy)  
pentachlorocyclotriphosphazene

Into a solution containing 10.8 grams (0.03 mole) of phosphonitrilic chloride trimer in 50 milliliters of acetone at a temperature of -60°C and under nitrogen atmosphere was added dropwise 3.1 milliliters (0.03 mole) of 2,6-lutidine in 10 milliliters of acetone and 5.0 grams (0.03 mole) of 2,4-dichlorophenol in 40 milliliters of acetone. The reaction mixture was allowed to warm to room temperature, stirred for about 16 hours, filtered and the filtrate poured into ice water. The solid (6.8 grams) was collected by filtration, and sublimation removed the unconverted 2,4-dichlorophenol. The pink semi-solid remaining in the sublimer was collected to give 0.9 gram (0.002 mole) of 2-(2',4'-dichlorophenoxy)pentachlorocyclotriphosphazene. NMR analysis of the product indicated the following: <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 7.20-7.55 ppm (m, aromatic protons).

This compound is referred to hereinafter as Compound 170.

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Example CIPreparation of 2,4-dichloro-6-(2',4'-dichlorophenoxy)hexahydro-1,3,5-triazine

Into a suspension containing 340 milligrams (0.001 mole) of 2,4-dichloro-6-(2',4'-dichlorophenoxy)-1,3,5-triazine in 50 milliliters of anhydrous ethyl ether was added 400 milligrams (0.01 mole) of sodium borohydride and 5 milliliters of methanol in portions. The mixture was stirred for 5 minutes and an additional 420 milligrams (0.01 mole) of sodium borohydride was added. After the mixture was stirred for 15 minutes, 150 milliliters of ether was added and the mixture then partitioned between ether and water. The organic layer was dried ( $\text{Na}_2\text{SO}_4$ ) and evaporated to give 340 milligrams (0.001 mole) of 2,4-dichloro-6-(2',4'-dichlorophenoxy)hexahydro-1,3,5-triazine as a white unstable solid. NMR analysis of the product indicated the following:

$^{13}\text{C}$  NMR( $\text{CD}_3\text{CN}/\text{D}_2\text{O}$ ):  $\delta$  118.53, 121.86, 124.87, 125.71, 128.82, 129.5, 130.09 and 130.93 ppm.

This compound is referred to hereinafter as Compound 171.

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Example CIIPreparation of 2,4-dichloro-6-  
[4-(4-ethoxyphenylazo)-1-naphthoxy]-  
1,3,5-triazine

In a manner similar to that employed in Example LIII, 2,4-dichloro-6-[4-(4-ethoxyphenylazo)-1-naphthoxy]-1,3,5-triazine was prepared having a melting point of 173°C-177°C. Elemental analysis of the product indicated the following:

Analysis:	C <sub>21</sub> H <sub>15</sub> Cl <sub>2</sub> N <sub>5</sub> O <sub>2</sub>
Calculated:	C, 57.29; H, 3.43; N, 15.90
Found:	C, 57.52; H, 4.08; N, 15.66

This compound is referred to hereinafter as Compound 172.

Example CIIIPreparation of 2,4-dichloro-6-(2-methoxyphenoxy)-  
1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 2-methoxyphenol in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-(2-methoxyphenoxy)-1,3,5-triazine having a melting point of 93°C-94.5°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_{10}H_7Cl_2N_3O_2$   
Calculated: C, 44.14; H, 2.59; N, 15.44  
Found: C, 43.99; H, 3.00; N, 15.27

This compound is referred to hereinafter as Compound 173.

Example CIV

Preparation of 2,4-dichloro-6-(2-benzyloxyphenoxy)-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 2-benzyloxyphenol in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-(2-benzyloxyphenoxy)-1,3,5-triazine having a melting point of 92°C-94°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{16}H_{11}Cl_2N_3O_2$   
Calculated: C, 55.19; H, 3.18; N, 12.07  
Found: C, 55.59; H, 3.19; N, 11.76

This compound is referred to hereinafter as Compound 174.

Example CV

Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-propoxyphenyl]ethyl)phenoxy]-1,3,5-triazine

Part A. Preparation of 4-[1-methyl-1-(4-propoxyphenyl)ethyl]phenol

A mixture of Bisphenol A (5.0 grams, 0.02 mole), potassium carbonate (3.04 grams, 0.02 mole)



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and 100 milliliters of acetophenone was stirred and heated at a temperature of 150°C for a period of 2 hours. After cooling to room temperature, 1-iodopropane (3.22 milliliters, 0.03 mole) was added and the mixture was then stirred and heated at a temperature of 100°C for a period of about 16 hours. The reaction mixture was then allowed to cool and the solid removed by filtration. The acetophenone was removed by distillation under reduced pressure and the residue purified by flash chromatography (5% ethyl acetate/hexane eluant) to give 2.12 grams (0.008 mole) of 4-[1-methyl-1-(4-propoxyphenyl)-ethyl]phenol. NMR analysis of the phenol intermediate indicated the following: <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 0.80-1.91 (m, 11H), 3.90 (t, 2H, J = 7Hz), 5.15 (s, H), 6.57-7.21 (m, 8H) ppm.

Part B. Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-propoxyphenyl]-ethyl)]phenoxy-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 4-[1-methyl-1-(4-propoxyphenyl)-ethyl]phenol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-[4-(1-methyl-1-[4-propoxyphenyl]-ethyl)]phenoxy-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis:	C <sub>21</sub> H <sub>21</sub> Cl <sub>2</sub> N <sub>3</sub> O <sub>2</sub>
Calculated:	C, 60.30; H, 5.06; N, 10.04
Found:	C, 59.62; H, 5.06; N, 10.84

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This compound is referred to hereinafter as Compound 175.

Example CVI

Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine

Part A. Preparation of 4-[1-methyl-1-(4-methoxyphenyl)ethyl]phenol

In a manner similar to that employed in Part A of Example CV, Bisphenol A was reacted with methyl iodide in acetone solution and in the presence of potassium carbonate as an acid acceptor to give 4-[1-methyl-1-(4-methoxyphenyl)ethyl]phenol. NMR analysis of the phenol intermediate indicated the following: <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.63 (s, 6H), 3.77 (s, 3H), 5.62 (s, H), 6.55-7.27 (m, 8H) ppm.

Part B. Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 4-[1-methyl-1-(4-methoxyphenyl)ethyl]phenol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine having a melting point of 108°C-111°C. Elemental analysis of the product indicated the following:

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Analysis:  $C_{19}H_{17}Cl_2N_3O_2$ 

Calculated: C, 58.47; H, 4.39; N, 10.77

Found: C, 58.35; H, 4.40; N, 10.76

This compound is referred to hereinafter as Compound 176.

#### Example CVII

#### Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-benzyloxyphenyl]ethyl)]-phenoxy-1,3,5-triazine

##### Part A. Preparation of 4-[1-methyl-1-(4-benzyloxyphenyl)ethyl]phenol

In a manner similar to that employed in Part A of Example CV, Bisphenol A was reacted with benzyl chloride in acetone solution in the presence of potassium carbonate as an acid acceptor to give 4-[1-methyl-1-(4-benzyloxyphenyl)ethyl]phenol. NMR analysis of the phenol intermediate indicated the following:  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  1.60 (s, 6H), 4.57 (s, H), 5.00 (s, 2H), 6.56-7.48 (m, 8H) ppm.

##### Part B. Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-benzyloxyphenyl]ethyl)]-phenoxy-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 4-[1-methyl-1-(4-benzyloxyphenyl)ethyl]phenol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-[4-(1-methyl-1-[4-benzyloxyphenyl]ethyl)]phenoxy-1,3,5-triazine having a melting point

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of 117.5°C-119°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{25}H_{21}Cl_2N_3O_2$   
Calculated: C, 64.39; H, 4.54; N, 9.01  
Found: C, 64.09; H, 4.59; N, 8.87

This compound is referred to hereinafter as Compound 177.

#### Example CVIII

#### Preparation of 2,4-dichloro-6-(2-n-butyloxyphenoxy)- 1,3,5-triazine

##### Part A. Preparation of 2-(n-butyloxy)phenol

In a manner similar to that employed in Part A of Example XXII, catechol was reacted with 1-bromobutane in the presence of sodium hydroxide as an acid acceptor to give 2-(n-butyloxy)phenol. NMR analysis of the phenol intermediate indicated the following:  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  0.73-1.95 (m, 7H), 3.63-4.08 (t, 2H), 6.02-7.32 (m, 4H) ppm.

##### Part B. Preparation of 2,4-dichloro-6-(2-n-butyloxy- phenoxy)-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 2-(n-butyloxy)phenol prepared in Part A above the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-(2-n-butyloxyphenoxy)-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

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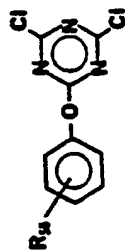
Analysis:  $C_{13}H_{13}Cl_2N_3O_2$   
Calculated: C, 49.70; H, 4.17; N, 13.37  
Found: C, 50.82; H, 4.69; N, 12.98

This compound is referred to hereinafter as Compound 178.

#### Example CIX

In a manner similar to that employed in Example CVIII, other compounds were prepared. The structures and analytical data for Compounds 179 through 184, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table N below.

TABLE II  
Representative Heterocyclic Nitrogen-Containing Compounds






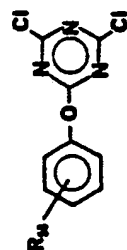



Compound No.	Substituents R <sub>55</sub>	Elemental Analysis						Melting Point (°C)
		Calculated		Found		N		
		C	H	C	H			
179		53.11	4.16	51.94	4.53	12.80	011	
180		57.46	4.02	57.44	4.05	11.01	164.5-165.5	
181		61.88	5.65	62.01	5.81	9.17	141.5-142.5	

TABLE W (Cont.)  
Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents R <sub>55</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
182		56.37	3.61	11.60	55.41	3.88	11.87	136.0-137.0
183		58.55	4.38	10.75	58.08	4.50	10.74	91.5-93.0
184		63.03	3.91	9.59	62.95	4.20	9.27	113.5-115.0

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Example CXPreparation of 2,4-dichloro-6-[4-(4-benzyloxy-phenylthio)]phenoxy-1,3,5-triazinePart A. Preparation of 4-[(4-benzyloxyphenylthio)]-phenol

A mixture of 5.0 grams (0.02 mole) of 4,4'-thiobisphenol, 3.79 grams (0.03 mole) of potassium carbonate and 75 milliliters of acetone was heated under reflux for a period of 2 hours. After cooling to room temperature, 4.35 grams (0.03 mole) of benzyl chloride added dropwise to the reaction mixture which was then heated under reflux for a period of 16 hours. The reaction mixture was then cooled to room temperature and filtered through Celite to remove solid materials. The filtrate was concentrated in vacuo and the residue purified by flash chromatography to give 2.82 grams (0.01 mole) of 4-[(4-benzyloxy- phenylthio)]phenol. NMR analysis of the phenol intermediate indicated the following: <sup>1</sup>H NMR (CDCl<sub>3</sub>):  $\delta$  4.98 (s, H), 5.08 (s, 2H), 6.65-7.50 (m, 13H) ppm.

Part B. Preparation of 2,4-dichloro-6-[4-(4-benzyloxyphenylthio)]phenoxy-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 4-[(4-benzyloxyphenylthio)]phenol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-[4-(4-benzyloxyphenylthio)]phenoxy-1,3,5-triazine having a melting point of 119°C-120°C.



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Elemental analysis of the product indicated the following:

Analysis:  $C_{22}H_{15}Cl_2N_3O_2S$

Calculated: C, 57.90; H, 3.31; N, 9.20

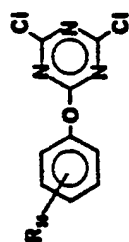
Found: C, 58.49; H, 3.60; N, 8.94



This compound is referred to hereinafter as Compound 185.

#### Example CXI

In a manner similar to that employed in Example CX, other compounds were prepared. The structures and analytical data for Compounds 186 and 187, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table O below.

**TABLE Q**  
**Representative Heterocyclic Nitrogen-Containing Compounds**



Compound No.	Substituents	Elemental Analysis				Melting Point (°C)	
		Calculated		Found			
	R56	C	H	C	H		
186		52.95	3.70	52.89	3.72	10.56	77.0-80.0
187		50.54	2.92	50.33	3.17	10.72	107.0-109.0

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Example CXIIPreparation of 2-chloro-4-methyl-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine

To a stirred solution of 0.72 gram (0.002 mole) of 2,4-dichloro-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine prepared in Example CVI in 50 milliliters of tetrahydrofuran was slowly added 2.04 milliliters (0.006 mole) of 2.7 M methylmagnesium bromide in ethyl ether solution while cooling the mixture in an ice bath. After this period, the reaction mixture was allowed to warm to room temperature and then stirred for a period of 15 hours. The solvents were removed by vacuum evaporation and the residue purified by flash chromatography (3% ethyl acetate in hexane eluant) to give 0.43 grams (0.001 mole) of 2-chloro-4-methyl-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine as pale yellow crystals having a melting point of 65.0°C-67.5°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{20}H_{20}ClN_3O_2$

Calculated: C, 64.95; H, 5.45; N, 11.36

Found: C, 64.58; H, 5.57; N, 11.25

This compound is referred to hereinafter as Compound 188.

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Example CXIIIPreparation of 2,4-dichloro-6-[4-(chloro-phenylsulfonyl)]phenoxy-1,3,5-triazinePart A. Preparation of 4-chlorophenyl 4'-hydroxy-phenyl sulfone

To a stirred solution of 28.7 grams (0.1 mole) of bis(4-chlorophenyl) sulfone in 100 milliliters of dimethylsulfoxide was added a solution of 13.1 grams (0.23 mole) of potassium hydroxide in 15 milliliters of water over a 10 minute period while heating the reaction mixture at a temperature of 40°C. The reaction mixture was then heated at a temperature of 105°C for a period of 5 hours, cooled to room temperature and poured into 300 milliliters of water. A white, milky precipitate was filtered off and the filtrate acidified with HCl. The aqueous solution was extracted with ether (3 x 100 milliliters) and the combined ether layers washed with 10% aqueous NaOH (2 x 50 milliliters). The combined basic layers were acidified with HCl and extracted with ether (2 x 50 milliliters). Evaporation of ether gave 19.21 grams (0.08 mole) of 4-chlorophenyl 4'-hydroxyphenyl sulfone having a melting point of 143.0°C-146.0°C.

Part B. Preparation of 2,4-dichloro-6-[4-(4-chloro-phenylsulfonyl)]phenoxy-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 4-chlorophenyl 4'-hydroxyphenyl sulfone prepared in Part A above in the presence of

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2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-[4-(4-chlorophenylsulfonyl)]phenoxy-1,3,5-triazine having a melting point of 167°C.

Elemental analysis of the product indicated the following:

Analysis:  $C_{15}H_8Cl_3N_3O_3S$

Calculated: C, 43.24; H, 1.93; N, 10.08

Found: C, 43.16; H, 2.01; N, 10.01

This compound is referred to hereinafter as Compound 189.

#### Example CXIV

##### Preparation of bis[4-(4,6-dichloro-1,3,5-triazine-2-yloxy)phenyl] sulfone

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with bis(4-hydroxyphenyl) sulfone in the presence of 2,6-lutidine as an acid acceptor to give bis [4-(4,6-dichloro-1,3,5-triazin-2-yloxy)phenyl] sulfone having a melting point of 230°-235°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{18}H_8Cl_4N_6O_4$

Calculated: C, 39.58; H, 1.48; N, 15.39

Found: C, 41.30; H, 1.73; N, 14.61

This compound is referred to hereinafter as Compound 190.

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Example CXVPreparation of (4,6-dichloro-1,3,5-triazin-2-yl)  
(4,6-dimethoxy-1,3,5--triazin-2-yl)etherPart A. Preparation of 2,4,6-trimethoxy-  
1,3,5-triazine

To a stirred solution of 12.0 grams (0.30 mole) of sodium hydroxide in 100 milliliters of methanol was slowly added over a one hour period 18.5 grams (0.10 mole) of cyanuric chloride in small portions while maintaining the reaction temperature at 25°C-30°C. After this period, the reaction mixture was stirred at room temperature for a two hour period. The mixture was filtered and methanol evaporated from the filtrate under reduced pressure. The residue was vacuum dried and crystallized from water to give 4.3 grams (0.025 mole) of 2,4,6-trimethoxy-1,3,5-triazine having a melting point of 122°C-129°C. Reverse phase high pressure liquid chromatographic analysis indicated the product to be of approximately 75% purity.

Part B. Preparation of sodium 4,6-dimethoxy-  
1,3,5-triazin-2-olate

To a stirred solution of 1.86 grams (0.05 mole) of sodium hydroxide in 25 milliliters of methanol was added 4.0 grams (0.02 mole) of 2,4,6-tri-methoxy-1,3,5-triazine prepared in Part A above which was heated under reflux for a period of one hour. The solution was allowed to cool and the white solid collected and dried to give 3.95 grams

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(0.02 mole) of sodium 4,6-dimethoxy-1,3,5-triazin-2-olate.

Part C. Preparation of (4,6-dichloro-1,3,5-triazin-2-yl) (4,6-dimethoxy-1,3,5-triazin-2-yl) ether

Sodium 4,6-dimethoxy-1,3,5-triazin-2-olate (1.5 grams, 0.01 mole) prepared in Part B above was suspended in 25 milliliters of acetonitrile and the mixture cooled to a temperature of 5°C-10°C in an ice bath. A solution of 1.54 grams (0.01 mole) of cyanuric chloride in 25 milliliters of acetonitrile was then added dropwise with stirring while maintaining the temperature below 10°C. The reaction mixture was stirred in the ice bath and allowed to warm slowly to room temperature. After stirring for a 16 hour period, the reaction mixture was filtered and solvent removed by evaporation. A white solid residue was purified by flash chromatography (30% ethyl acetate in hexane) to give 1.34 grams (0.004 mole) of (4,6-dichloro-1,3,5-triazin-2-yl) (4,6-dimethoxy-1,3,5-triazin-2-yl) ether having a melting point of 158.5°C-160°C. Elemental analysis of the product indicated the following:

Analysis:  $C_8H_6Cl_2N_6O_3$

Calculated: C, 31.50; H, 1.98; N, 27.55

Found: C, 31.74; H, 2.07; N, 27.47

This compound is referred to hereinafter as Compound 191.

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Example CXVIPreparation of 2,2'-thiobis(4,6-dichloro-1,3,5-triazine)

To a stirred solution of 10.0 grams (0.05 mole) of cyanuric chloride in 100 milliliters of acetone was added a solution of 3.26 grams (0.01 mole) of sodium sulfide nonahydrate in 30 milliliters of water over a period of 30 minutes while maintaining the temperature of the reaction mixture at 0-5°C by external cooling. The reaction mixture was stirred at a temperature of 0-5°C for a period of 15 minutes and 150 milliliters of ice water was added. A white precipitate formed and was immediately filtered off and dried. Unreacted cyanuric chloride was removed from the crude product by vacuum sublimation and the remaining solid recrystallized from hexane/methylene chloride to give 2,2'-thiobis(4,6-dichloro-1,3,5-triazine) as a white solid having a melting point of 140°C-145°C. High pressure liquid chromatographic analysis showed the product to have a purity of 75%. Infrared analysis of the product indicated the following: IR ( $\text{CHCl}_3$ ) 1500, 1240, 850,  $\text{cm}^{-1}$ . Mass spectrometric analysis indicated m/e 330 (calculated molecular weight 329.98). This compound is referred to hereinafter as Compound 192.



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Example CXVIIPreparation of (4-chloro-6-methoxy-1,3,5-triazin-2-yl)(4,6-dimethoxy-1,3,5-triazin-2-yl) etherPart A. Preparation of 2,4-dichloro-6-methoxy-1,3,5-triazine

A mixture of 20.2 grams (0.11 mole) of cyanuric chloride, 18.4 grams (0.22 mole) of sodium bicarbonate, 100 milliliters of methanol and 125 milliliters of water was stirred for a period of 40 minutes at room temperature and then diluted with 100 milliliters of water and the resulting solid filtered off. The white solid was vacuum dried to give 13.4 grams (0.08 mole) of 2,4-dichloro-6-methoxy-1,3,5-triazine having a melting point of 88°C-90°C.

Part B. Preparation of (4-chloro-6-methoxy-1,3,5-triazin-2-yl) (4,6-di-methoxy-1,3,5-triazin-2-yl) ether

To a stirred suspension of 2.91 grams (0.02 mole) of sodium 4,6-dimethoxy-1,3,5-triazin-2-olate prepared in Part B of Example CXV in 50 milliliters of acetonitrile was added dropwise a solution of 2.93 grams (0.02 mole) of 2,4-dichloro-6-methoxy-1,3,5-triazine prepared in Part-A above. The reaction mixture was heated under reflux for a period of 48 hours and then refluxed for a second 48 hour period after addition of 1.17 grams (0.003 mole) of dibenzo-18-crown-6. The mixture was allowed to cool, diluted with 75 milliliters of methylene chloride and then filtered. After

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evaporation of solvents the residue was purified by flash chromatography (20% ethyl acetate in hexane eluant) to yield 1.60 grams (0.005 mole) of (4-chloro-6-methoxy-1,3,5-triazin-2-yl) (4,6-dimethoxy-1,3,5-triazin-2-yl) ether having a melting point of 126.5°C-128°C. Elemental analysis of the product indicated the following:

Analysis:  $C_9H_9ClN_6O_4$

Calculated: C, 35.95; H, 3.01; N, 27.95

Found: C, 35.92; H, 3.12; N, 28.08

This compound is referred to hereinafter as Compound 193.

#### Example CXVIII

##### Preparation of 2-chloro-4,6-dimethoxy-1,3,5-triazine

A mixture of 18.5 grams (0.10 mole) of cyanuric chloride, 16.8 grams (0.20 mole) of sodium bicarbonate, 57 milliliters of methanol and 5 milliliters of water was stirred vigorously and carbon dioxide evolution was observed as the reaction temperature rose to about 40°C. After a period of 20 minutes, carbon dioxide evolution had slowed and the reaction mixture was then heated under reflux for a period of 30 minutes. The mixture was cooled and diluted with water causing a white precipitate to separate. The solid was collected, waterwashed, vacuum dried and the crude product crystallized from cyclohexane to give 10.0 grams (0.06 mole) of 2-chloro-4,6-dimethoxy-1,3,5-triazine as a white crystalline solid having a

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melting point of 69°C-71°C. Elemental analysis of the product indicated the following:

Analysis:  $C_5H_6ClN_3O_2$   
Calculated: C, 34.20; H, 3.44; N, 23.93  
Found: C, 34.14; H, 3.60; N, 23.96

This compound is referred to hereinafter as Compound 194.

Example CXIX

Preparation of 6-(2,4-dichlorophenylazo)-  
2,4-dichloro-1,3,5-triazine

A slow stream of chlorine gas was passed for a period of ten minutes through a two-phase mixture consisting of a solution of 2.6 grams (0.008 mole) of N-(2,4-dichlorophenyl)-N'-(4,6-dichloro-1,3,5-triazin-2-yl)hydrazine in 75 milliliters of  $CHCl_3$  and a solution of 1.34 grams (0.02 mole) of  $NaHCO_3$  in 40 milliliters of water. Nitrogen was then bubbled through the mixture to remove excess chlorine and the organic layer was separated, washed with water and dried over anhydrous  $MgSO_4$  to yield 2.4 grams of a dark red solid. This was combined with 980 milligrams of product prepared from a previous identical reaction except that 1.0 gram (0.003 mole) of N-(2,4-dichlorophenyl)-N-(4,6-dichloro-1,3,5-triazin-2-yl)hydrazine was used. The combined products were flash-chromatographed on silica gel using a 9:1 v/v hexane-ethyl acetate eluent to yield the crude product as a red solid. This crude product was recrystallized from hexane to give a material which was sublimed giving 0.91 grams

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(0.003 mole) of 6-(2,4-dichlorophenylazo)-2,4-dichloro-1,3,5-triazine as a red solid having a melting point of 119°C-123°C. Elemental analysis of the product indicated the following:

Analysis:  $C_9H_3Cl_4N_5$

Calculated: C, 33.47; H, 0.94; N, 21.68

Found: C, 32.95; H, 0.97; N, 21.14

This compound is referred to hereinafter as Compound 195.

#### Example CXX

##### Preparation of 2-(4-methoxyphenyl)-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XL, cyanuric chloride was reacted with the Grignard reagent of 4-bromoanisole to give 2-(4-methoxy-phenyl)-4,6-dichloro-1,3,5-triazine having a melting point of 136.5°C-138.5°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{10}H_7Cl_2N_3O$

Calculated: C, 46.90; H, 2.76; N, 16.41

Found: C, 46.76; H, 2.78; N, 16.29

This compound is referred to hereinafter as Compound 196.

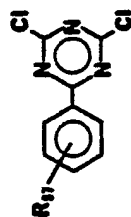
#### Example CXXI

In a manner similar to that employed in Example CXX, other compounds were prepared. The structures and analytical data for Compounds 197

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through 199, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table P below.

**TABLE B**  
**Representative Heterocyclic Nitrogen-Containing Compounds**



Compound No.	Substituents R <sub>57</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
197	4-CH <sub>3</sub>	50.03	2.94	17.50	50.58	3.17	17.36	148.0-150.5
198	4-Cl	41.50	1.55	16.13	41.13	1.83	16.06	150.0-151.0
199	2,4-Cl <sub>2</sub>	36.65	1.03	14.25	36.27	1.39	14.19	143.0-145.0

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Example CXXIIPreparation of 2-[(2-phenoxy)ethoxy]-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XXXII, 2-phenoxyethanol was reacted with cyanuric chloride in the presence of 2,6-lutidine as an acid acceptor to give 2-[(2-phenoxy)ethoxy]-4,6-dichloro-1,3,5-triazine having a melting point of 81°C-83°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{11}H_9Cl_2N_3O_2$

Calculated: C, 46.17; H, 3.17; N, 14.69

Found: C, 46.41; H, 3.44; N, 14.68

This compound is referred to hereinafter as Compound 200.

Example CXXIIIPreparation of 2-[2-(2,4-dichlorophenoxy)ethoxy]-4,6-dichloro-1,3,5-triazinePart A. Preparation of 2-(2,4-dichlorophenoxy)-ethanol

To a solution of 2.44 grams (0.06 mole) of NaOH in 20 milliliters of water was added 10.0 grams (0.06 mole) of 2,4-dichlorophenol portionwise. A 4.8 milliliter (0.07 mole) portion of 2-bromoethanol was then added and the mixture heated at a temperature of 60°C for a period of approximately 16 hours. After cooling, the reaction mixture was extracted with dichloromethane and the combined organic extracts then washed with 1N NaOH solution and water and then dried over  $MgSO_4$ . Concentra-

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tion under reduced pressure gave 8.02 grams (0.04 mole) of 2-(2,4-dichlorophenoxy)ethanol. NMR analysis of the phenol intermediate indicated the following:  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  2.73 (m, H), 3.7-4.4 (m, 4H), 6.97 (d, H,  $J = 8\text{Hz}$ ), 7.33 (dd, H,  $J = 3, 8\text{Hz}$ ), 7.47 (d, H,  $J = 3\text{Hz}$ ) ppm.

Part B. Preparation of 2-[2-(2,4-dichlorophenoxy)-ethoxy]-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XXXII, cyanuric chloride was reacted with 2-(2,4-dichlorophenoxy)ethanol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2-[2-(2,4-dichlorophenoxy)ethoxy]-4,6-dichloro-1,3,5-triazine having a melting point of  $103^\circ\text{C}$ - $104.5^\circ\text{C}$ . Elemental analysis of the product indicated the following:

Analysis:  $\text{C}_{11}\text{H}_7\text{Cl}_4\text{N}_3\text{O}_2$

Calculated: C, 37.21; H, 1.99; N, 11.84

Found: C, 37.06; H, 2.19; N, 11.73

This compound is referred to hereinafter as Compound 201.

Example CXXIV

Preparation of 2-[(2,4-dichlorobenzoyloxy)-ethoxy]-4,6-dichloro-1,3,5-triazine

Part A. Preparation of 2-(2,4-dichlorobenzoyloxy)-ethanol

To a slurry of 125 grams of neutral alumina in 125 milliliters of ether was added 5.0 grams



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(0.03 mole) of 2,4-dichlorobenzyl alcohol and 62.5 milliliters (0.12 mole) of a 2M solution of ethylene oxide in ether. This mixture was stirred for a period of approximately 16 hours at room temperature, poured into 500 milliliters of methanol and allowed to stand for 6 hours. The alumina was filtered off, washed with methanol and the filtrate concentrated under reduced pressure to give 9.26 grams of crude product as a clear liquid. This was combined with 2.6 grams of crude product prepared from a previous identical reaction except that 2.0 grams (0.01 mole) of 2,4-dichlorobenzyl alcohol was used. The combined products were flash-chromatographed using hexane-ethyl acetate (1:1 v/v) as the eluant to give 1.3 grams (0.006 mole) of 2-(2,4-dichlorobenzoyloxy) ethanol as a colorless liquid. NMR analysis of this intermediate indicated the following: <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.47 (br s, H), 3.5-4.0 (m, 4H), 4.60 (s, 2H), 7.1-7.6 (m, 3H) ppm.

Part B. Preparation of 2-[(2,4-dichlorobenzoyloxy)-ethoxy]-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XXXII, cyanuric chloride was reacted with 2-(2,4-dichlorobenzoyloxy)ethanol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2-[(2,4-dichlorobenzoyloxy)-ethoxy]-4,6-dichloro-1,3,5-triazine as a colorless oil. Elemental analysis of the product indicated the following:

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Analysis:  $C_{12}H_9Cl_4N_3O_2$ 

Calculated: C, 39.05; H, 2.46; N, 11.39

Found: C, 39.82; H, 2.55; N, 11.32

This compound is referred to hereinafter as Compound 202.

Example CXXV

Preparation of 2-(2-[2-(2,4-dichlorophenoxy)-ethoxy]ethoxy)-4,6-dichloro-1,3,5-triazine

Part A. Preparation of 2-[2-(2,4-dichlorophenoxy)-ethoxy]ethanol

In a manner similar to that employed in Part A of Example CXXIII, 2,4-dichlorophenol was reacted with 2-(2-chloroethoxy)ethanol in the presence of sodium hydroxide as an acid acceptor to give 2-[2-(2,4-dichlorophenoxy)ethoxy]ethanol as a colorless liquid. NMR analysis of this intermediate indicated the following:  $^1H$  NMR ( $CDCl_3$ )  $\delta$  2.83 (br s, H), 3.5-4.0 (m, 6H), 4.1-4.4 (m, 2H), 6.83 (d, H,  $J = 2$  Hz), 7.20 (dd, H,  $J = 2.8$  Hz), 7.37 (d, H,  $J = 2$  Hz) ppm.

Part B. Preparation of 2-(2-[2-(2,4-dichlorophenoxy)ethoxy]ethoxy)-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XXXII, cyanuric chloride was reacted with 2-[2-(2,4-dichlorophenoxy)ethoxy]ethanol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2-(2-[2-(2,4-dichlorophenoxy)-

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ethoxy]ethoxy)-4,6-dichloro-1,3,5-triazine having a melting point of 59.5°C-61.5°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{13}H_{11}Cl_2N_3O_3$   
Calculated: C, 39.12; H, 2.78; N, 10.53  
Found: C, 38.65; H, 2.76; N, 10.71

This compound is referred to hereinafter as Compound 203.

#### Example CXXVI

#### Preparation of 2-[4-(2,4-dichlorophenyl)butoxy]- 4,6-dichloro-1,3,5-triazine

##### Part A. Preparation of 2-(2,4-dichlorophenyl) ethyl bromide

A mixture of 30.1 grams (0.16 mole) of 2,4-dichlorophenethyl alcohol prepared in Part A of Example XLVIII and 140 milliliters of 48% aqueous HBr was heated under reflux for a period of 5 hours. After cooling, the reaction mixture was partitioned between ether and water and the ethereal phase then extracted with saturated aqueous  $NaHCO_3$ , dried over  $MgSO_4$  and concentrated under reduced pressure to give a brown liquid. Kugelrohr distillation gave 29.7 grams (0.12 mole) of 2-(2,4-dichloro-phenyl)ethyl bromide as a colorless liquid having a boiling point of 70°C at 0.025 mm Hg. NMR analysis of this intermediate indicated the following:  $^1H$  NMR ( $CDCl_3$ )  $\delta$  3.0-3.8 (m, 4H), 7.0-7.4 (m, 3H) ppm.

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Part B. Preparation of 4-(2,4-dichlorophenyl)-  
butan-1-ol

To 0.96 grams (0.04 mole) of magnesium turnings in 20 milliliters of anhydrous tetrahydrofuran was added dropwise a solution of 2-(2,4-dichloro-phenyl)ethyl bromide prepared in Part A above in 30 milliliters of tetrahydrofuran. When the magnesium had been consumed, the yellow solution of Grignard reagent was added dropwise to a cold (-30°C) mixture of 1.9 grams (0.01 mole) of cuprous iodide in 30 milliliters of tetrahydrofuran. This mixture was stirred for a period of 5 minutes and 35 milliliters of tetrahydrofuran was added. This mixture was stirred for a period of 5 minutes and 35 milliliters (0.07 mole) of a 2M solution of ethylene oxide was then added dropwise. The reaction mixture was stirred for a period of 2 hours at a temperature of 0°C and a 1 hour period at room temperature and then quenched with 50 milliliters of water. The volume was reduced in vacuo and the residue extracted with ether. The ethereal layer was dried ( $\text{MgSO}_4$ ) and concentrated under reduced pressure to give a liquid which was chromatographed on silica gel to give 2.37 grams (0.01 mole) of 4-(2,4-dichlorophenyl)butan-1-ol as a pale yellow liquid. NMR analysis of this intermediate indicated the following:  $^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  1.43-1.83 (m, 4H), 2.53-2.90 (m, 3H), 3.50-3.77 (m, 2H), 7.07 (m, 2H), 7.33 (m, H) ppm.

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Part C. Preparation of 2-[4-(2,4-dichlorophenyl)-  
butoxy]-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XXXII, cyanuric chloride was reacted with 4-(2,4-dichlorophenyl)butan-1-ol prepared in Part B above in the presence of 2,6-lutidine as an acid acceptor to give 2-[4-(2,4-dichlorophenyl)butoxy]-4,6-dichloro-1,3,5-triazine as a pale yellow oil. Elemental analysis of the product indicated the following:

Analysis:  $C_{13}H_{11}Cl_4N_3O$   
Calculated: C, 42.53; H, 3.02; N, 11.45  
Found: C, 43.30; H, 3.08; N, 10.76

This compound is referred to hereinafter as Compound 204.

Example CXXVII

Preparation of 2,4-dichloro-6-(2,4-dichloro-  
3,5-dimethylphenoxy)-1,3,5-triazine

In a manner similar to that employed in Example I, cyanuric chloride was reacted with 2,4-dichloro-3,5-dimethylphenol in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-(2,4-dichloro-3,5-dimethylphenoxy)-1,3,5-triazine having a melting point of 118°C-120°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{11}H_7Cl_4N_3O$   
Calculated: C, 38.97; H, 2.08; N, 12.39  
Found: C, 39.18; H, 2.25; N, 12.47

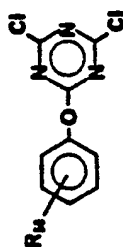
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This compound is referred to hereinafter as Compound 205.

Example CXXVIII

In a manner similar to that employed in Example CXXVII, other compounds were prepared. The structures and analytical data for Compounds 206 through 210, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table Q below.

TABLE Q  
Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents R <sub>58</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
206	2,3,4,5,6-F <sub>5</sub>	32.56	--	12.66	32.72	--	12.46	88-90
207	3-CH <sub>3</sub>	38.73	1.30	13.55	39.12	1.36	13.29	88-90
208	2,4-F <sub>2</sub>	IR (KBr) 1490, 1400, 1290, 1245, 1190, 1140, 1000, 960, 840, 795 cm <sup>-1</sup>						98-101
209	2-Cl-4-NO <sub>2</sub>	33.62	0.94	17.43	33.88	1.08	17.55	131-133
210	4-H <sub>2</sub> N-C(=O) O	42.13	2.12	19.65	42.71	2.67	19.30	189-191

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Example CXXIXPreparation of acetone O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime

In a manner similar to that employed in Example XXXVI, cyanuric chloride was reacted with acetone oxime in the presence of sodium bicarbonate as an acid acceptor to give acetone O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime having a melting point of 60°C-62°C. Elemental analysis of the product indicated the following:

Analysis:  $C_6H_6Cl_2N_4O$

Calculated: C, 32.60; H, 2.74; N, 25.35

Found: C, 32.24; H, 2.90; N, 25.28

This compound is referred to hereinafter as Compound 211.

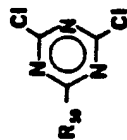
Example CXXX

In a manner similar to that employed in Example LXXIII, other compounds were prepared. The structures and analytical data for Compounds 212 and 213, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table R below.



TABLE B

## Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
212	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CEC-	44.47	3.27	19.45	40.13	2.72	19.47	011
213	(CH <sub>3</sub> ) <sub>3</sub> CC <sub>3</sub> CT	46.98	3.94	18.26	47.86	4.21	17.41	011

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Example CXXXIPreparation of 2-chloro-4-ethynyl-6-methoxy-  
1,3,5-triazine

To 1.0 gram (0.004 mole) of 2,4-dichloro-6-trimethylsilylethynyl-1,3,5-triazine prepared in Example LXXII in methanol solution was added 0.235 gram (0.004 mole) of potassium fluoride at a temperature of 0°C. The reaction mixture was stirred for a period of 30 minutes, a saturated aqueous solution of ammonium chloride was added and the methanol then evaporated in vacuo. The residue was extracted with ether and the ether solution was dried over  $\text{Na}_2\text{SO}_4$ , filtered and evaporated to give 0.33 gram (0.002 mole) of 2-chloro-4-ethynyl-6-methoxy-1,3,5-triazine having a melting point of 108°C-110°C. Elemental analysis of the product indicated the following:

Analysis:  $\text{C}_6\text{H}_4\text{ClN}_3\text{O}$

Calculated: C, 42.50; H, 2.38; N, 24.78

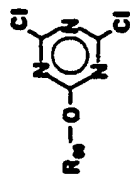
Found: C, 41.58; H, 2.29; N, 23.91

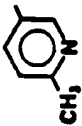
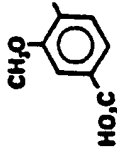
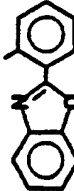
This compound is referred to hereinafter as Compound 214.

Example CXXXII

In a manner similar to that employed in Example LXI, other compounds were prepared. The structures and analytical data for Compounds 215 through 217, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table S below.

TABLE S  
Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents R <sub>60</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
215		42.05	2.35	21.79	39.68	2.98	19.60	160-162 (dec)
216		41.79	2.23	13.29	41.14	3.02	13.77	110-138
217		53.50	2.25	15.60	53.46	2.66	15.48	118-120

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Example CXXXIIIPreparation of 2,4-dichloro-6-phenylsulfonamido-  
1,3,5-triazine

In a manner similar to that employed in Example LXXIV, cyanuric chloride was reacted with benzenesulfonamide in the presence of sodium hydroxide as an acid acceptor to give 2,4-dichloro-6-phenylsulfonamido-1,3,5-triazine having a melting point of 185°C-186°C. Elemental analysis of the product indicated the following:

Analysis:  $\text{C}_9\text{H}_6\text{Cl}_2\text{N}_4\text{O}_2\text{S}$

Calculated: C, 35.42; H, 1.98; N, 18.36

Found: C, 35.04; H, 2.32; N, 18.09

This compound is referred to hereinafter as Compound 218.

Example CXXXIVPreparation of 2-chloro-4-(2,4-dichlorophenoxy)-  
6-hexafluoroisopropoxy-1,3,5-triazine

To a solution of 5.0 grams (0.02 mole) of 2,4-dichloro-6-(2,4-dichlorophenoxy)-1,3,5-triazine prepared in Example IV in 100 milliliters of acetone was added at a temperature of 40°C a solution of 1.9 milliliters (0.02 mole) of 2,6-lutidine in 75 milliliters of acetone followed by a solution of 1.9 milliliters (0.02 mole) of hexafluoroisopropyl alcohol in 75 milliliters of acetone. The resulting mixture was heated under reflux for a period of 10 hours and then evaporated to dryness in vacuo. The residue was subjected to flash column chromatography on silica gel by first eluting with 5% ethyl acetate

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in hexane and then with 15% dichloromethane in hexane to give 1.34 grams (0.0035 mole) of 2-chloro-4-(2,4-dichlorophenoxy)-6-hexafluoroisopropoxy-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis:  $C_{12}H_4Cl_3F_6N_3O_2$   
Calculated: C, 37.38; H, 1.05; N, 10.90  
Found: C, 32.52; H, 0.89; N, 9.48

This compound is referred to hereinafter as Compound 219.

#### Example CXXXV

##### Preparation of 2-chloro-4-(1-naphthoxy)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazine

In a manner similar to that employed in Example CXXXIV, 2,4-dichloro-6-(1-naphthoxy)-1,3,5-triazine prepared in Example IX was reacted with 2,2,2-trifluoroethanol in the presence of 2,6-lutidine as an acid acceptor to give 2-chloro-4-(1-naphthoxy)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis:  $C_{15}H_{19}ClFN_3O_2$   
Calculated: C, 50.65; H, 2.55; N, 11.81  
Found: C, 51.04; H, 2.75; N, 11.53

This compound is referred to hereinafter as Compound 220.

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Example CXXXVIPreparation of 2-chloro-4-(2,4-dichlorophenoxy)-  
6-ethoxy-1,3,5-triazine

To a suspension of 0.39 gram (0.02 mole) of magnesium in 70 milliliters of dry tetrahydrofuran was added a solution of 3.17 grams (0.02 mole) of bromoacetaldehyde diethyl acetal in 10 milliliters of dry tetrahydrofuran. The resulting mixture was stirred at room temperature for a period of 1 hour and a solution of 5.0 grams (0.02 mole) of 2,4-dichloro-6-(2,4-dichloro-phenoxy)-1,3,5-triazine was then added dropwise. The reaction mixture was stirred at room temperature for a period of approximately 16 hours, evaporated to dryness and the residue purified by flash-column chromatography on silica gel by eluting with 5% ethyl acetate in hexane to give 1.9 grams (0.01 mole) of 2-chloro-4-(2,4-dichlorophenoxy)-6-ethoxy-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis:  $C_{11}H_8Cl_3N_3O_2$   
Calculated: C, 41.22; H, 2.51; N, 13.11  
Found: C, 41.24; H, 2.50; N, 12.75

This compound is referred to hereinafter as Compound 221.

Example CXXXVIIPreparation of 2,4-dichloro-6-(2,2,2-trichloroethoxy)-1,3,5-triazine

To a solution of 5.0 grams (0.03 mole) of cyanuric chloride in 100 milliliters of acetone was

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added at a temperature of 4°C a solution of 3.16 milliliters (0.03 mole) of 2,6-lutidine followed by a solution of 2.60 milliliters (0.03 mole) of 2,2,2-trichloroethanol in 150 milliliters of acetone. The mixture was stirred at room temperature for a period of about 16 hours and the solvent was removed by evaporation. The residue was partitioned between water and dichloromethane, the organic layer dried over anhydrous sodium sulfate and the residue, following evaporation of solvents, purified by flash column chromatography on silica gel. Elution by ethyl acetate-hexane gave 1.1 grams (0.004 mole) of 2,4-dichloro-6-(2,2,2-trichloroethoxy)-1,3,5-triazine as yellow crystals having a melting point of 72°C-73°C. Elemental analysis of the product indicated the following:

Analysis:  $C_5H_2Cl_2N_3O$

Calculated: C, 20.20; H, 0.68; N, 14.13

Found: C, 20.19; H, 0.68; N, 14.48

This compound is referred to hereinafter as Compound 222.

#### Example CXXXVIII

##### Preparation of 2,4-dichloro-6-[2-(N-methylpyrrolyl)]-1,3,5-triazine

A mixture of 2.4 milliliters (0.03 mole) of N-methylpyrrole, 5.0 grams (0.03 mole) of cyanuric chloride and 50 milliliters of p-dioxane was heated under reflux for a period of 5 hours. The reaction mixture was poured into water and the precipitate which formed was collected by suction filtration and

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dried. Crystallization from hexane gave 2.0 grams (0.01 mole) of 2,4-dichloro-6-[2-(N-methylpyrrolyl)]-1,3,5-triazine as pale yellow crystals having a melting point of 153°C-154°C. Elemental analysis of the product indicated the following:

Analysis:  $C_8H_6Cl_2N_4$   
Calculated: C, 41.95; H, 2.64; N, 24.46  
Found: C, 42.00; H, 2.73; N, 24.46

This compound is referred to hereinafter as Compound 223.

#### Example CXXXIX

##### Preparation of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2-oxohexamethyleneimine

To a suspension of 10.0 grams (0.09 mole) of potassium hydride in oil was added 200 milliliters of dry tetrahydrofuran at a temperature of -60°C followed by the addition of 10.0 grams (0.09 mole) of  $\epsilon$ -caprolactam at the same temperature. The mixture was warmed to room temperature and stirred for a period of one hour after which a solution of 16.3 grams (0.09 mole) of cyanuric chloride in 100 milliliters of tetrahydrofuran was added and stirring continued for an additional two hour period. The reaction mixture was vacuum evaporated and the residue purified by flash chromatography to give 1.2 grams (0.005 mole) of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2-oxohexamethyleneimine as an oil. Elemental analysis of the product indicated the following:



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Analysis:  $C_9H_{10}Cl_2N_4O$   
Calculated: C, 41.40; H, 3.86; N, 21.46  
Found: C, 40.85; H, 4.40; N, 21.01

This compound is referred to hereinafter as Compound 224.

Example CXL

Preparation of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2-oxotetramethyleneimine

In a manner similar to that employed in Example CXXXIX, 2-pyrrolidinone was treated with potassium hydride and the resulting potassium salt was then reacted with cyanuric chloride to give N-(4,6-dichloro-1,3,5-triazin-2-yl)-2-oxotetramethyleneimine having a melting point of 192°C-194°C. Elemental analysis of the product indicated the following:

Analysis:  $C_7H_6Cl_2N_4O$   
Calculated: C, 36.07; H, 2.60; N, 24.04  
Found: C, 35.86; H, 2.54; N, 24.01

This compound is referred to hereinafter as Compound 225.

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Example CXLIPreparation of N-(4,6-dichloro-1,3,5-triazin-2-yl)-1,3,3-trimethyl-6-aza-bicyclo [3.2.1]octane and 2,4-bis(1,3,3-trimethyl-6-azabicyclo [3.2.1] octan-6-yl)-6-chloro-1,3,5-triazine

In a manner similar to that employed in Example CXXXIX, 1,3,3-trimethyl-6-azabicyclo [3.2.1] octane was treated with potassium hydride and the resulting potassium salt was then reacted with cyanuric chloride to give N-(4,6-dichloro-1,3,5-triazin-2-yl)-1,3,3-trimethyl-6-azabicyclo [3.2.1] octane having a melting point of 133°C-135°C and 2,4-bis(1,3,3-trimethyl-6-azabicyclo [3.2.1] octan-6-yl)-6-chloro-1,3,5-triazine having a melting point of 161.5°C-163°C by separating the two products by flash column chromatography. Elemental and NMR analysis of the two products indicated the following:

N-(4,6-dichloro-1,3,5-triazin-2-yl)-1,3,3-trimethyl-6-azabicyclo [3.2.1] octane

Analysis:	$C_{12}H_{18}Cl_2N_3$
Calculated:	C, 51.83; H, 6.02; N, 18.60;
	Cl, 23.54
Found:	C, 51.82; H, 5.81; N, 18.47;
	Cl, 23.78

This compound is referred to hereinafter as Compound 226.

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2,4-Bis(1,3,3-trimethyl-6-azabicyclo[3.2.1]octan-6-yl)-6-chloro-1,3,5-triazine

<sup>1</sup>H NMR (CDCl<sub>3</sub>):  $\delta$  0.80 (s, 6H), 0.94 (s, 6H), 1.10 (s, 6H), 1.30-2.30 (m, 12H), 2.90-3.70 (m, 4H), 4.30-4.68 (m, 2H) ppm.

This compound is referred to hereinafter as Compound 227.

Example CXLII

Preparation of 4,6-dichloro-2-(3-phenylphenoxy)-1,3,5-triazine

In a manner similar to that employed in Example X, cyanuric chloride was reacted with 3-phenylphenol in the presence of triisopropanolamine as an acid acceptor to give 4,6-dichloro-2-(3-phenylphenoxy)-1,3,5-triazine having a melting point of 183°C-185°C. Elemental analysis of the product indicated the following:

Analysis: C<sub>15</sub>H<sub>9</sub>N<sub>3</sub>O

Calculated: C, 56.63; H, 2.85; N, 13.21;  
Cl, 22.29

Found: C, 56.33; H, 3.29; N, 13.15;  
Cl, 21.55

This compound is referred to hereinafter as Compound 228.

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Example CXLIIIPreparation of 2,3-dichloro-N-(2-chloroanilino)  
maleimide

A stirred mixture of 5.0 grams (0.03 mole) of o-chlorophenylhydrazine hydrochloride, 4.7 grams (0.03 mole) of dichloromaleic anhydride and 20 milliliters of acetic acid was heated at a temperature of 100°C for a period of 45 minutes. The mixture was cooled to room temperature and water was added dropwise causing a precipitate to form. The first crop of product was filtered off and a second crop was obtained by slow evaporation of the mother liquor and a second filtration. Combining the two crops gave 5.55 grams (0.02 mole) of 2,3-dichloro-N-(2-chloroanilino)maleimide as yellow crystals having a melting point of 137°C-138°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{10}H_5Cl_3N_2O_2$

Calculated: C, 41.20; H, 1.73; N, 9.61

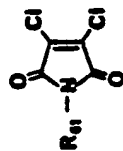
Found: C, 40.80; H, 1.97; N, 9.75

This compound is referred to hereinafter as Compound 229.

Example CXLIV

In a manner similar to that employed in Example CXLIII, other compounds were prepared. The structures and analytical data for Compounds 230 through 250, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table T below.

TABLE I  
Representative Heterocyclic Nitrogen-Containing Compounds





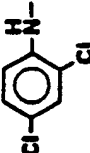
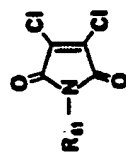
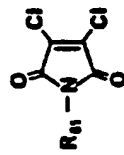
Compound No.	Substituents R <sub>61</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
230		46.72	2.35	10.89	46.69	2.36	10.79	166-182
231		41.20	1.73	9.61	40.68	1.73	9.34	173-174
232		36.85	1.24	8.59	36.68	1.40	8.47	184.5-185

TABLE I (cont.)  
Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents R <sub>61</sub>	Elemental Analysis				Melting Point (°C)
		Calculated C H N	Found C H N			
233		40.64 1.55 8.62	40.73 1.63 8.62			174.5-175.5
234		46.02 2.81 9.76	46.06 2.82 9.78			136-138
235		46.02 2.81 9.76	46.08 2.71 9.66			126-128

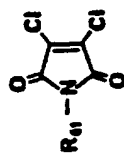
TABLE I (Cont.)  
Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents R <sub>61</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
236		39.76	1.67	13.91	39.66	1.69	13.86	183-185
237		51.59	2.76	5.47	51.79	2.86	5.44	107-109
238		40.65	1.55	4.31	40.65	1.63	4.48	142.5-144

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TABLE I (Cont.)  
Representative Heterocyclic Nitrogen-Containing Compounds



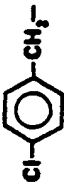


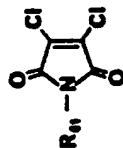
Compound No.	Substituents R <sub>61</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
239		45.47	2.08	4.82	45.83	2.22	4.58	108-110.5
240		50.38	3.17	4.90	49.69	3.57	4.69	101-102
241		56.39	4.39	4.70	55.94	4.38	4.71	70-71



TABLE I (Cont.)  
Representative Heterocyclic Nitrogen-Containing Compounds



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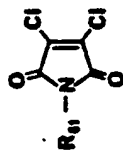



Compound No.	Substituents R <sub>61</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
242		50.55	3.53	9.82	50.34	3.66	9.70	140.5-141.5
243		53.56	3.36	5.19	53.49	3.47	5.19	011
244		53.36	3.36	5.19	53.58	3.30	5.14	131-132

TABLE I (Cont.)  
Representative Heterocyclic Nitrogen-Containing Compounds

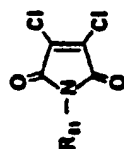





Compound No.	Substituents R <sub>61</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
245		43.93	2.05	5.69	44.16	2.21	5.76	55-56
246		46.18	3.88	5.98	45.64	3.91	6.25	66.5-67
247		48.41	4.47	5.65	48.36	4.51	5.31	138-140

4  
H +

4  
H +

TABLE I (Cont.)  
Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents R <sub>61</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
248		40.81	2.45	6.80	41.03	2.49	6.68	118.5-120
249		46.34	2.12	9.82	46.33	2.11	9.84	227-229
250		37.40	1.88	8.72	37.36	1.80	8.78	186.5-189

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Example CXLVPreparation of 6-hydroxy-2-phenyl-  
3(2H)pyridazinone

A stirred mixture of 10 milliliters (0.10 mole) of phenylhydrazine, 10 grams (0.10 mole) of maleic anhydride and 75 milliliters of acetic acid was heated under reflux for a period of 6 hours. The mixture was cooled to room temperature causing separation of crystals which were filtered off giving 10.62 grams (0.05 mole) of 6-hydroxy-2-phenyl-3(2H)pyridazinone as yellow crystals having a melting point of 262°C (decomposition). NMR analysis indicated the following: <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 7.21 (AB<sub>q</sub>, 2H, J = 10 Hz), 7.50-7.87 (m, 5H) ppm.

This compound is referred to hereinafter as Compound 251.

Example CXLVIPreparation of 4,6-dichloro-2-phenyl-  
3(2H)pyridazinone

A stirred mixture of 30 milliliters (0.32 mole) of phosphorus oxychloride, 30 grams (0.14 mole) of phosphorus pentachloride and 5.0 grams (0.024 mole) of 6-hydroxy-2-phenyl-3(2H)pyridazinone prepared in Example CXLV was heated at a temperature of 160°C-170°C for a period of 90 minutes. The mixture was cooled to room temperature and poured into ice water giving a yellow precipitate. The crude product was filtered off and crystallized from methylene-chloride-hexane to give

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2.1 grams (0.01 mole) of 4,6-dichloro-2-phenyl-3(2H)-pyridazinone as yellow crystals having a melting point of 110°C-111°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{10}H_6Cl_2N_2O$

Calculated: C, 49.33; H, 2.56; N, 11.18

Found: C, 49.69; H, 2.61; N, 11.57

This compound is referred to hereinafter as Compound 252.

#### Example CXLVII

##### Preparation of 6-chloro-2-phenyl-3(2H)pyridazinone

A stirred mixture of 2.0 grams (0.01 mole) of 6-hydroxy-2-phenyl-3-(2H)pyridazinone prepared in Example CXLV and 20 milliliters (0.21 mole) of phosphorus oxychloride was heated at a temperature of 95°C for a period of 2 hours. The reaction mixture was cooled to room temperature and then quenched with ice water. Hexane was added and the mixture was triturated giving white crystals. These crystals were filtered off to give 0.81 gram (0.004 mole) of 6-chloro-2-phenyl-3(2H)pyridazinone as off-white crystals having a melting point of 112°C-113°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{10}H_7ClN_2O$

Calculated: C, 58.13; H, 3.42; N, 13.56;  
Cl, 17.16

Found: C, 58.10; H, 3.10; N, 13.41;  
Cl, 16.47

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This compound is referred to hereinafter as Compound 253.

Example CXLVIII

Preparation of 4,5-dichloro-6-hydroxy-2-(2,4-dichlorophenyl)-3(2H)pyridazinone

Into a mixture of 18.8 grams (0.09 mole) of 2,4-dichlorophenylhydrazine hydrochloride and 600 milliliters of 6N hydrochloric acid was added 14.7 grams (0.09 mole) of dichloromaleic anhydride. The mixture was heated under reflux for a period of 6 hours and the resulting solid was filtered off and washed with ice water and hexane to give 7.6 grams (0.023 mole) of 4,5-dichloro-6-hydroxy-2-(2,4-dichlorophenyl)-3(2H)pyridazinone having a melting point of 295°C-298°C (decomposition). Elemental analysis of the product indicated the following:

Analysis:  $C_{10}H_4Cl_4N_2O_2$

Calculated: C, 36.85; H, 1.24; N, 8.59

Found: C, 36.69; H, 1.37; N, 8.44

This compound is referred to hereinafter as Compound 254.

Example CXLIX

Preparation of 4,5-dichloro-6-hydroxy-2-(2-chlorophenyl)-3(2H)pyridazinone

In a manner similar to that employed in Example CXLVIII, o-chloro-phenylhydrazine hydrochloride was reacted with dichloromaleic

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anhydride to give 4,5-dichloro-6-hydroxy-2-(2-chlorophenyl)-3(2H)pyridazinone having a melting point of 242°C-244°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{10}H_5Cl_3N_2O_2$   
Calculated: C, 41.20; H, 1.73; N, 9.61  
Found: C, 41.19; H, 1.97; N, 9.60

This compound is referred to hereinafter as Compound 255.

#### Example CL

##### Preparation of 4,5-dichloro-6-hydroxy-2-(3,4-dichlorophenyl)-3(2H)pyridazinone

A stirred mixture of 7.5 grams (0.03 mole) of 3,4-diphenylhydrazine hydrochloride, 5.0 grams (0.3 mole) of dichloromaleic anhydride and 100 milliliters of glacial acetic acid was heated under reflux for a period of 2 days. The mixture was cooled to room temperature causing yellow-orange crystals to separate. Suction filtration of the crystals gave 2.87 grams (0.01 mole) of 4,5-dichloro-6-hydroxy-2-(3,4-dichlorophenyl)-3(2H)-pyridazinone having a melting point of 241°C-242.5°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{10}H_4Cl_4N_2O_2$   
Calculated: C, 36.85; H, 1.24; N, 8.59  
Found: C, 36.47; H, 2.07; N, 7.49

This compound is referred to hereinafter as Compound 256.

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Example CLIPreparation of 2,3-dichloro-N-(2-methylanilino)-  
maleimide and 4,5-dichloro-6-hydroxy-2-  
(2-methylphenyl)-3(2H)pyridazinone

In a manner similar to that employed in Example CXLIII, o-tolylhydrazine hydrochloride was reacted with dichloromaleic anhydride to give 2,3-dichloro-N-(2-methylanilino)maleimide having a melting point of 146°C-149°C and 4,5-dichloro-6-hydroxy-2-(2-methylphenyl)-3(2H)pyridazinone having a melting point of 234°C-235.5°C by separating the two products by recrystallization from methylene chloride. Elemental analysis of these two products indicated the following:

2,3-dichloro-N-(2-methylanilino)maleimideAnalysis:  $C_{11}H_8Cl_2N_2O_2$ 

Calculated: C, 48.73; H, 2.97; N, 10.33

Found: C, 48.64; H, 3.12; N, 10.23

This compound is referred to hereinafter as Compound 257.

4,5-dichloro-6-hydroxy-2-(2-methylphenyl)-  
3(2H)pyridazinoneAnalysis:  $C_{11}H_8Cl_2N_2O_2$ 

Calculated: C, 48.73; H, 2.97; N, 10.33

Found: C, 48.29; H, 3.06; N, 10.16

This compound is referred to hereinafter as Compound 258.



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Example CLIIPreparation of 4,5,6-trichloro-2-(2,4-dichlorophenyl)-3(2H)pyridazinone

A stirred mixture of 3.7 grams (0.02 mole) of phosphorus pentachloride, 37 milliliters (0.4 mole) of phosphorus oxychloride and 7.6 grams (0.023 mole) of 4,5-dichloro-6-hydroxy-2-(2,4-dichlorophenyl)-3(2H)pyridazinone prepared in Example CXLVIII was heated at a temperature of 160°C-170°C for a period of 14 hours. The mixture was cooled to room temperature and poured into ice water with addition of a small amount of hexane and stirring to promote precipitation. The crude product was filtered, washed with ice water and purified by flash chromatography on silica gel by eluting with 5% ethyl acetate in hexane to give 0.85 gram (0.0025 mole) of 4,5,6-trichloro-2-(2,4-dichlorophenyl)-3(2H)pyridazinone having a melting point of 154°C-155.5°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{10}H_3Cl_5N_2O$

Calculated: C, 34.88; H, 0.88; N, 8.13

Found: C, 34.30; H, 0.96; N, 8.20

This compound is referred to hereinafter as Compound 259.

Example CLIII

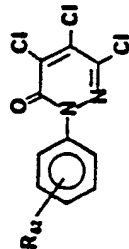
In a manner similar to that employed in Example CLII, other compounds were prepared. The structure and analytical data for Compounds 260

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through 264, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table U below.

TABLE U

## Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents R <sub>62</sub>	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
260	H	43.59	1.83	10.17	43.33	1.81	10.01	109-110
261	2-CH <sub>3</sub>	45.63	2.44	9.67	45.63	2.53	9.12	130-132
262	2-Cl	38.75	1.30	9.04	38.89	1.39	8.79	150-152
263	3,4-Cl <sub>2</sub>	34.88	0.88	8.13	36.34	1.23	8.30	150-154
264	3-CF <sub>3</sub>	38.46	1.17	8.15	38.50	1.14	8.06	109-110

Example CLIV

Preparation of 2,3-dimethyl-N-(2-chloroanilino)-  
maleimide

A stirred mixture of 7.1 grams (0.04 mole) of o-chlorophenylhydrazine hydrochloride, 5.0 grams (0.04 mole) of 2,3-dimethylmaleic anhydride and 25 milliliters of acetic acid was heated at a temperature of 100°C for a period of 1 hour. The reaction mixture was cooled to room temperature and water was added dropwise causing a precipitate to form. The precipitate was filtered off and the filtrate was cooled causing the crude product to separate as a solid. The solid was crystallized from methylene chloride-hexane to give 2.3 grams (0.01 mole) of 2,3-dimethyl-N-(2-chloroanilino)-maleimide as orange crystals having a melting point of 115°C-117.5°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{12}H_{11}ClN_2O_2$

Calculated: C, 57.49; H, 4.42; N, 11.17

Found: C, 57.49; H, 4.32; N, 11.15

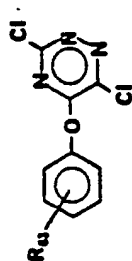
This compound is referred to hereinafter as Compound 265.

Example CLV

In a manner similar to that employed in Part B of Example LXXXIII, other compounds were prepared. The structures and analytical data for Compounds 266 and 267, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table V below.

TABLE V

Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents	Elemental Analysis						Melting Point (°C)
		Calculated			Found			
		C	H	N	C	H	N	
266	2,4-F <sub>2</sub>	38.88	1.08	15.11	38.87	1.37	15.03	89-91
267	2,3-(CH=CHCH=CH)-	53.45	2.42	14.38	53.65	2.83	14.66	135-137

Example CLVI

Preparation of N-Hydroxymaleimide

N-Hydroxymaleimide having a melting point of 133°C-135°C was purchased from the Aldrich Chemical Company and used without further purification. A log P determination for the product indicated the following: Octanol/Water Log P by Reversed Phase HPLC 0.00. This compound is referred to hereinafter as Compound 268.

Example CLVII

Preparation of 4,5-dichloro-6-hydroxy-2-(3-trifluoromethylphenyl)-3(2H)pyridazinone

In a manner similar to that employed in Example CXLVIII, m-trifluoro-methylphenylhydrazine hydrochloride was reacted with dichloromaleic anhydride to give 4,5-dichloro-6-hydroxy-2-(3-trifluoromethylphenyl)-3(2H)pyridazinone having a melting point of 171°C-172°C. Elemental analysis of the product indicated the following:

Analysis:	$C_{11}H_5Cl_2F_3N_2O_2$
Calculated:	C, 40.64; H, 1.55; N, 8.62
Found:	C, 40.55; H, 1.50; N, 8.61

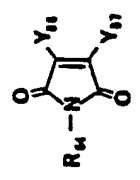
This compound is referred to hereinafter as Compound 269.

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Example CLVIII

In a manner similar to that employed in Example CXLIII, other compounds were prepared. The structures and analytical data for Compounds 270 through 275, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table W below.

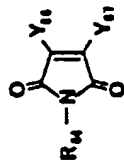
TABLE M  
Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents			Elemental Analysis						Melting Point (°C)
	R64	Y86	Y87	Calculated			Found			
				C	H	N	C	H	N	
270		Cl	Cl	48.21	2.94	5.11	48.05	2.28	5.05	92-93.5
271		Cl	Cl	48.21	2.94	5.11	48.14	2.28	5.05	72-73
272		H	Br	49.65	3.03	5.26	49.73	3.03	5.24	51-52



TABLE W (Cont.)  
Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents			Elemental Analysis						Melting Point (°C)
	R64	Y86	Y87	Calculated			Found			
				C	H	N	C	H	N	
273		Cl	Cl	48.21	2.94	5.11	47.98	2.29	5.05	115-116
274		Cl	Cl	41.24	1.92	5.34	41.37	2.06	5.22	86.5-88
275		Cl	Cl	50.40	5.00	5.34	50.65	4.98	5.30	109-110.5

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Example CLIXPreparation of 2-methyl-4,5,6-trichloro-  
3(2H)pyridazinonePart A. Preparation of 2-methyl-4,5-dichloro-  
6-hydroxy-3(2H)pyridazinone

In a manner similar to that employed in Example CXLVIII, methyl hydrazine was reacted with dichloromaleic anhydride in aqueous HCl solution to give 2-methyl-4,5-dichloro-6-hydroxy-3(2H)pyridazinone having a melting point of 229°C-230°C.

Part B. Preparation of 2-methyl-4,5,6-trichloro-  
3(2H)pyridazinone

A mixture of 3.0 grams (0.02 mole) of 2-methyl-4,5-dichloro-6-hydroxy-3(2H)pyridazinone prepared in Part A above and 20 milliliters of phosphorus oxychloride was warmed until a solution was obtained and the excess of phosphorus oxychloride was evaporated under reduced pressure. The residue was immersed in ice water and this mixture was then stirred for a period of 1 hour giving a slurry of a buff solid which was isolated and dried over  $P_2O_5$  to give 0.6 gram (0.003 mole) of 2-methyl-4,5,6-trichloro-3(2H)pyridazinone having a melting point of 96°C-98°C.

This compound is referred to hereinafter as Compound 276.

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Example CLXPreparation of 2-benzyl-4,5-dichloro-  
3(2H)pyridazinonePart A. Preparation of 4,5-dichloro-  
3(2H)pyridazinone

To a refluxing solution of 33.6 grams (0.2 mole) of mucochloric acid in 160 milliliters of absolute ethanol was slowly added a solution of 6.7 grams (0.2 mole) of 95% hydrazine in 20 milliliters of ethanol. Refluxing was continued for a period of 2 hours after completing the feed and the mixture was then cooled causing separation of solids which were filtered off and air dried to give 24.4 grams (0.15 mole) of 4,5-dichloro-3(2H)pyridazinone having a melting point of 193°C-194°C.

Part B. Preparation of 2-benzyl-4,5-dichloro-  
3(2H)pyridazinone

A mixture of 6.6 grams (0.04 mole) of 4,5-dichloro-3(2H)pyridazinone prepared in Part A above, 9.1 milliliters (0.08 mole) of benzyl chloride, 20 grams (0.14 mole) of potassium carbonate and 120 milliliters of N,N-dimethylformamide was heated at a temperature of 40°C-90°C causing the mixture to form a gel. The mixture was acidified, extracted with ether/acetone and filtered to give a brown solid. The filtrate was partitioned between ether and water, the ether phase washed with 10% sodium carbonate solution and with water, and then dried and evaporated to give 0.5 gram (0.002 mole) of

2-benzyl-4,5-dichloro-3(2H)pyridazinone as white crystals having a melting point of 81°C-82°C. This compound is referred to hereinafter as Compound 277.

Example CLXI

Preparation of 2-(o-chlorobenzyl)-4,5-dichloro-3(2H)pyridazinone

A mixture of 3.4 grams (0.02 mole) of mucochloric acid, 5.1 grams (0.02 mole) of o-chlorobenzylhydrazine  $H_2SO_4$  salt and 50 milliliters of absolute ethanol was heated under reflux for a period of 6 hours. The mixture was cooled and the precipitate which formed was collected and air-dried to give 3.8 grams (0.01 mole) of 2-(o-chlorobenzyl)-4,5-dichloro-3(2H)-pyridazinone as white crystals having a melting point of 114°C. This compound is referred to hereinafter as Compound 278.

Example CLXII

Preparation of 2-chloro-N-(2-methylphenyl)-maleimide

Part. A. Preparation of 2-(or 3-)chloro-N-(2-methylphenyl)maleamic acid

A mixture of 132 grams (1.0 mole) of chloromaleic anhydride and xylene was stirred and heated at a temperature of 70°C while slowly

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feeding in 107 grams (1.0 mole) of 2-methylaniline by means of a dropping funnel. On completing the 2-methylaniline feed, the reaction mixture was stirred for a period of one hour at a temperature of 70°C. The mixture was then cooled and a solid filtered off, washed with xylene, and hexane and then dried at room temperature to give 225 grams (0.94 mole) of 2-(or 3-)chloro-N-(2-methylphenyl)-maleamic acid having a melting point of 110°C.

Part B. Preparation of 2-chloro-N-(2-methylphenyl)maleimide

To a stirred mixture of 8 grams (0.10 mole) of sodium acetate and 95.0 grams (0.40 mole)

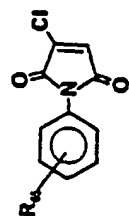
of 2-(or 3-)chloro-N-(2-methylphenyl)maleamic acid prepared in Part A above was added 122.0 grams (1.2 moles) of acetic anhydride at room temperature and the resulting mixture then stirred and heated at a temperature of 80°C for a period of 40 minutes. The reaction mixture was then cooled to a temperature of 25°C and added to 2 liters of ice water. The resulting mixture was extracted with 600 milliliters of ethyl ether and the ether extract then distilled through a one-foot unpacked column to give 75.0 grams (0.34 mole) of 2-chloro-N-(2-methylphenyl)maleimide having a boiling point of 132°C at 2 mm Hg.

This compound is referred to hereinafter as Compound 279.

Example CLXIII

In a manner similar to that employed in Example CLXII, other compounds were prepared. The structures and analytical data for Compounds 280 through 283, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table X below.

TABLE X

Representative Heterocyclic Nitrogen-Containing Compounds

<u>Compound No.</u>	<u>Substituents</u>	<u>Physical Properties</u>
	<u>R<sub>6</sub></u>	
280	3-CH <sub>3</sub>	Boiling point 139°C-140°C/3 mm Hg
281	4-CH <sub>3</sub>	Melting point 148°C
282	2,4-(CH <sub>3</sub> ) <sub>2</sub>	Boiling point 148°C-150°C/2 mm Hg
283	2-C <sub>2</sub> H <sub>5</sub>	Boiling point 136°C/2 mm Hg

Example CLXIV

Preparation of N-ethylmaleimide

N-Ethylmaleimide was purchased from the Aldrich Chemical Company and used without further purification. A log P determination for the product indicated the following: Octanol/Water Log P by Reversed Phase HPLC 1.10. This compound is referred to hereinafter as Compound 284.

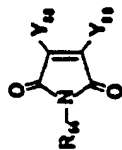
Example CLXV

Additional compounds were purchased from the Maybridge Chemical Company, Limited, Trevillet, Tintagel, Cornwall, United Kingdom and evaluated for activity. The structures and analytical data for Compounds 285 through 288, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table Y below.



TABLE V

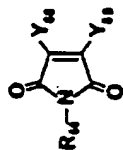
## Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents			Octanol/Water Log P by Reversed Phase HPLC
	R <sub>66</sub>	Y <sub>88</sub>	Y <sub>89</sub>	
285		H	Br	2.31
286		Cl	Cl	2.74
287		Cl	Cl	2.57

TABLE V (Cont.)

Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents			Octanol/Water Log P by Reversed Phase HPLC
	R66	Y88	Y89	
288		H	H	1.83

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Example CLXVIPreparation of 2-(3-trifluoromethyl)-4,5-dichloro-3(2H)pyridazinone

2-(3-Trifluoromethyl)-4,5-dichloro-3(2H)pyridazinone was purchased from the Aldrich Chemical Company and used without further purification. A log P determination for the product indicated the following: Octanol/Water Log P by Reversed Phase HPLC 2.90.

This compound is referred to hereinafter as Compound 289.

Example CLXVIIPreparation of N-(2-ethoxyphenyl)succinimide

A mixture of 50 grams (0.5 mole) of succinic anhydride and 300 milliliters of toluene was stirred and heated at a temperature of 115°C-120°C and 69 grams (0.5 mole) of 2-ethoxyaniline was fed to this mixture from a dropping funnel. The reaction mixture was then heated to boiling and toluene distilled off to a kettle temperature of 180°C-190°C. The mixture was heated at a temperature of 180°C-190°C until the theoretical amount of water distilled from the system. The reaction mixture was cooled, diluted with one liter of 99% isopropyl alcohol and allowed to stand for a period of about 16 hours. The separated solid was filtered off, washed with isopropyl alcohol and dried to give 72.0 grams (0.33 mole) of N-(2-ethoxyphenyl)succinimide having a

melting point of 108°C. Elemental analysis of the product indicated the following:

Analysis:  $C_{12}H_{13}NO_3$   
Calculated: N, 6.39  
Found: N, 6.73

This compound is referred to hereinafter as Compound 290.

Example CLXVIII

Preparation of 3,5-dichloro-6-(3,5-dichloro-4-methoxyphenyl)-4-hydroxypyridazine

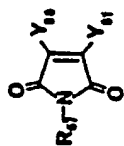
3,5-dichloro-6-(3,5-dichloro-4-methoxyphenyl)-4-hydroxypyridazine was obtained as a sample from the Chemie Linz Company and used without further purification. NMR analysis of the product indicated the following:  $^1H$  NMR ( $CDCl_3$ /DMSO- $d_6$ )  $\delta$  164.50, 152.77, 147.92, 141.99, 131.05, 130.58, 128.88, 128.34 and 60.51 ppm.

This compound is referred to hereinafter as Compound 291.

Example CLXIX

In a manner similar to that employed in Example CXLIII, other compounds were prepared. The structures and analytical data for Compounds 292 through 296, which compounds are used in the examples hereinafter for reducing moisture loss from plants are set forth in Table Z below.

TABLE 2  
Representative Heterocyclic Nitrogen-containing Compounds



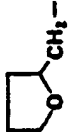
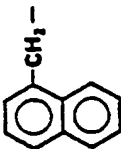
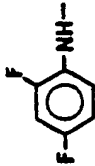
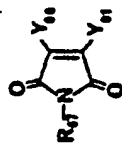


Compound No.	Substituents			Elemental Analysis						Melting Point (°C)
	R <sub>67</sub>	Y <sub>90</sub>	Y <sub>91</sub>	Calculated		Found		M		
				C	H	C	H			
292		Cl	Cl	43.23	3.63	43.02	3.86	5.34	011	
293		Cl	Cl	58.85	2.96	58.93	3.16	4.58	128-130	
294		Cl	Cl	40.99	1.38	41.06	1.35	9.58	124.5-125.	

TABLE 2

Representative Heterocyclic Nitrogen-Containing Compounds



Compound No.	Substituents			Elemental Analysis						Melting Point (°C)
	R <sub>67</sub>	Y <sub>90</sub>	Y <sub>91</sub>	Calculated			Found			
				C	H	N	C	H	N	
295		Cl	Cl	33.76	0.81	11.25	33.11	1.13	10.79	132-136
296		Cl	H	59.61	3.64	6.32	59.48	3.64	6.28	011

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Example CLXXEffect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Leaf Diffusion Resistance and Transpiration Rate

Leaf diffusion resistance is a measurement of the resistance to diffusion of water vapor from a leaf and is indicative of the transpiration rate. Transpiration rate is a measurement of the evaporation of water from cell walls and diffusion of the water out of the leaf through the stomata for a given time period. The relationship between leaf diffusion resistance and transpiration rate can be summarized as follows: the higher the leaf diffusion resistance, the lower the transpiration rate; and the lower the leaf diffusion resistance, the higher the transpiration rate. As used in Table AA below, leaf diffusion resistance and transpiration rate were determined according to the following general procedure:

Solutions of the test compounds were prepared by dissolving 30.3 milligrams of compound in 5.5 milliliters of acetone and then adding water to a final volume of 11.0 milliliters. If clouding of the solution occurred as the water was added, the use of water was discontinued and acetone was added to a final volume of 11.0 milliliters. The resulting stock solutions contained 2530 parts per million by weight of compound. The test concentrations in parts of the test compound per million parts by weight of final solution employed

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in the tests in Table AA below were obtained by appropriate dilutions of the stock suspensions with water.

Into 13.5 centimeter diameter plastic pots containing a potting soil mix, i.e., one-third sandy loam soil, one-third peat moss and one-third perlite by volume, were sown three snapbean seeds (Phaseolus vulgaris var. Cranberry). Five to seven days after planting, the plants were thinned to one plant per pot. Ten to twelve days after planting at the time of full expansion of the primary leaves, each concentration of the test compounds (each pot sprayed with 5 milliliters of solution) was applied to three snapbean plants as a foliar spray by use of an aspirated spray apparatus set at 10 psig air pressure. As a control, a water-acetone solution containing no test compound was also sprayed on three snapbean plants. When dry, all of the plants were placed in a greenhouse at a temperature of  $80^{\circ}\text{F} \pm 5^{\circ}\text{F}$  and humidity of 50 percent  $\pm$  5 percent. At 24 hours and 48 hours after treatment, leaf diffusion resistance in seconds/centimeter (sec/cm) and transpiration rate in micrograms of water/square centimeter  $\cdot$  second ( $\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$ ) were determined using a LI-COR 1600 steady-state porometer commercially available from Li-Cor, Inc./Li-Cor, Ltd., Lincoln, Nebraska. The values obtained for each test compound concentration and control were averaged to obtain the results in Table AA.



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TABLE AA

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

<u>Compound No.</u>	<u>Leaf Diffusion Resistance (sec/cm)</u>		<u>Transpiration Rate (<math>\mu</math>g H<sub>2</sub>O/cm<sup>2</sup>. sec)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
1	13.8	3.3	0.3	1.4
2	14.0	6.0	1.3	3.3
3	12.1	3.4	0.8	2.3
4	15.5(c)	5.6	0.6(c)	2.2
5	7.8	4.8	1.2	1.9
6	16.5	4.3	0.5	1.7
7	11.0	5.5	0.6	1.2
8	14.0	3.3	0.5	1.7
9	7.5	6.0	0.8	1.0
10	4.6	2.2	0.8	1.5
11	4.6	2.2	0.8	1.6
12	4.8(c)	2.5	0.8(c)	1.2
13	12.7	7.6	1.0	1.5
14	4.9	2.9	0.8	1.2
15	25.8	5.0	0.4	1.6
16	18.0	5.7	0.5	1.5
17	11.1	5.8	0.8	1.3
18	9.4	4.9	1.0	2.2
19	9.9	6.0	0.8	1.3
20	18.0	5.4	0.7	2.1
21	8.7	1.7	1.1	5.0
22	8.9	2.8	1.0	2.9
23	13.6	4.7	0.8	2.0
24	24.9(b)	4.6	0.4(b)	1.8
25	26.5	5.8	0.6	2.5

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TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

Compound No.	Leaf Diffusion		Transpiration Rate	
	<u>Resistance (sec/cm)</u>		<u>(<math>\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}</math>)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
26	24.8	6.2	0.4	1.9
27	6.9(b)	2.2	2.3(b)	6.5
28	5.9	1.9	2.6	5.9
29	13.8	4.3	0.8	2.9
30	30.7	3.7	0.4	2.8
31	28.2	6.1	0.6	2.6
32	16.6	3.4	0.9	3.6
33	11.8	6.4	0.9	1.7
34	10.7	5.6	0.7	1.2
35	12.9(b)	5.7	0.5(b)	1.3
36	7.2	3.8	0.9	1.6
37	6.7	3.8	0.6	1.0
38	4.4	2.5	0.7	1.4
39	5.1	2.5	0.7	1.4
40	7.6	3.0	0.6	1.5
41	3.6	3.0	1.0	1.4
42	14.6	4.0	0.4	1.5
43	13.7	9.3	0.6	0.9
44	16.7	4.3	1.0	3.5
45	6.6	5.9	1.7	1.8
46	9.3	3.3	2.3	4.0
47	25.6	3.8	0.7	4.1

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TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

Compound <u>No.</u>	<u>Leaf Diffusion</u> <u>Resistance (sec/cm)</u>		<u>Transpiration Rate</u> <u>(<math>\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}</math>)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
48	10.1(b)	9.4	0.8(b)	0.9
49	10.2	9.1	1.1	1.3
50	9.3	4.8	1.0	1.9
51	15.8	5.6	0.5	1.5
52	13.2	3.3	1.8	3.4
53	11.6	4.4	0.5	1.3
54	7.8	2.4	1.0	3.3
55	8.4	4.3	1.1	3.3
56	16.1	6.2	1.0	2.5
57	6.4	2.1	1.3	3.7
58	3.8	2.8	1.7	2.3
59	8.2	2.8	0.8	2.2
60	3.9	1.8	2.1	3.8
61	9.5	5.6	0.9	1.5
62	15.4	5.5	0.6	1.5
63	8.5	6.9	1.1	1.4
64	8.7	4.2	1.6	3.3
65	21.7	13.9	0.4	0.8
66	11.2(c)	8.5	0.7(c)	0.8
67	10.7	8.1	0.7	0.9
68	5.2	4.4	1.2	1.4
69	12.1	4.4	0.5	1.3

TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

Compound No.	Leaf Diffusion		Transpiration Rate	
	<u>Resistance (sec/cm)</u>		<u>(<math>\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}</math>)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
70	3.4	2.2	0.8	1.3
71	2.5	2.0	1.4	1.6
72	14.4	2.1	1.4	4.3
73	5.4	3.6	1.4	2.0
74	5.0(b)	3.2	0.9(b)	1.4
75	10.3	6.3	1.3	1.8
76	12.7	7.4	1.0	1.7
77	13.5	4.4	0.6	1.9
78	10.3	3.7	1.1	2.8
79	19.8	5.3	0.4	1.4
80	14.4(c)	7.6	0.8(c)	1.5
81	10.1(c)	4.7	1.0(c)	2.0
82	19.0	6.1	0.5	1.3
83	26.7	6.5	0.3	1.2
84	7.4(c)	6.5	1.1(c)	1.3
85	13.4	9.2	1.0	1.6
86	6.8	4.0	1.1	1.5
87	14.8	4.3	0.9	2.8
88	6.5	6.8	1.0	1.2
89	11.4(b)	9.7	1.0(b)	1.2
90	10.4(e)	5.8	1.2(e)	2.0
91	4.8	3.3	1.6	2.2

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TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

Compound No.	Leaf Diffusion Resistance (sec/cm)		Transpiration Rate ( $\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$ )	
	1840 ppm	Control	1840 ppm	Control
92	9.5	3.9	0.7	1.6
93	8.1	3.5	0.9	2.0
94	12.0	6.8	0.8	1.3
95	10.0(b)	6.4	0.9(b)	1.4
96	10.0	6.5	1.0	1.4
97	3.1	1.7	1.6	2.1
98	2.7	1.3	1.4	2.6
99	17.1	9.9	0.5	0.9
100	6.2	4.3	1.3	1.8
101	15.2(b)	7.9	0.7(b)	1.3
102	13.3(b)	4.7	0.9(b)	2.0
103	10.5(b)	5.5	1.8(b)	2.5
104	8.6	2.1	1.2	4.2
105	9.9	5.4	0.9	1.6
106	12.3	10.1	1.0	1.3
107	7.4	2.4	0.5	1.4
108	22.8	9.5	0.4	1.0
109	7.1	5.1	1.4	2.0
110	14.2(b)	6.3	0.7(b)	1.4
111	11.2	5.7	0.8	1.4
112	10.9	6.7	1.0	1.6
113	13.3(b)	5.6	0.6(b)	1.3

TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

Compound No.	Leaf Diffusion		Transpiration Rate	
	Resistance (sec/cm)		(μg H <sub>2</sub> O/cm <sup>2</sup> . sec)	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
114	15.0(b)	6.0	0.6(b)	1.4
115	8.0	6.6	0.9	1.1
116	8.6	7.0	1.2	1.7
117	13.5	3.6	0.7	2.2
118	3.3	2.0	1.2	1.8
119	8.7	7.1	0.6	0.8
120	10.1	9.8	1.1	1.3
121	11.4	5.7	0.7	1.3
122	8.7(b)	6.6	0.8(b)	1.4
123	1.9	1.0	2.4	3.9
124	1.8(b)	1.3	2.3(b)	2.6
125	8.9	6.6	0.8	1.1
126	6.2	5.8	1.2	1.3
127	7.9	5.4	1.0	1.4
128	12.4	5.8	0.7	1.6
129	5.1	4.2	1.1	1.4
130	6.8	5.0	0.8	1.0
131	11.2	5.0	0.6	1.3
132	12.6(c)	7.3	0.9(c)	1.5
133	6.6	4.3	1.3	2.0
134	11.0	8.4	1.3	1.5
135	9.7	8.3	1.2	1.5

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TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

Compound No.	Leaf Diffusion Resistance (sec/cm)		Transpiration Rate ( $\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$ )	
	1840 ppm	Control	1840 ppm	Control
136	3.9	3.7	2.4	2.6
137	6.4(c)	5.7	1.3(c)	1.4
138	6.7(c)	2.6	0.6(c)	1.4
139	7.7(c)	5.3	1.0(c)	1.5
140	8.8	7.1	1.5	1.8
141	10.8(c)	6.2	0.7(c)	1.2
142	8.4(c)	6.7	1.3(c)	1.8
143	6.5	5.2	1.3	1.7
144	8.1	4.9	0.9	1.4
145	12.6(c)	8.6	0.8(c)	1.1
146	8.4	8.2	1.1	1.2
147	7.8	4.8	1.1	1.7
148	11.1(c)	7.4	0.5(c)	0.8
149	6.3(c)	5.4	1.4(c)	1.6
150	5.5(c)	4.6	1.4(c)	1.6
151	8.3	6.1	1.7	2.3
152	12.7(c)	6.5	0.7(c)	1.3
153	14.9	2.3	0.6	3.5
154	9.4(b)	8.1	0.8(b)	1.0
155	28.4(b)	6.7	0.3(b)	1.1
156	12.0	5.8	0.6	1.2
157	9.5	2.2	0.6	1.9

TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

<u>Compound</u> <u>No.</u>	<u>Leaf Diffusion</u> <u>Resistance (sec/cm)</u>		<u>Transpiration Rate</u> <u>(<math>\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}</math>)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
158	10.8	5.0	0.6	1.3
159	6.3	1.9	0.7	1.6
160	6.5	4.4	0.9	1.4
161	17.2	8.2	0.3	0.8
162	4.3(a)	3.4	0.9(a)	1.2
163	3.2(a)	2.6	1.0(a)	1.3
164	4.6	4.4	2.3	2.4
165	4.0	3.6	2.5	2.9
166	5.6(d)	4.9	1.1(d)	1.3
167	9.9	9.7	1.2	1.3
168	4.2	3.5	2.2	2.7
169	5.4	5.2	1.9	2.1
170	6.8	3.1	1.2	3.0
171	6.4	5.2	1.2	1.5
172	11.2	8.1	1.1	1.4
173	22.2	4.9	0.5	2.0
174	10.6	6.3	0.8	1.9
175	6.4	4.2	1.8	2.6
176	6.3	4.9	2.1	2.6
177	7.3	6.6	1.4	1.6
178	38.0	5.5	0.5	3.1
179	12.4	4.8	1.1	2.3



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TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

Compound No.	Leaf Diffusion		Transpiration Rate	
	<u>Resistance (sec/cm)</u>		<u>(<math>\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}</math>)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
180	7.3	6.9	1.7	1.8
181	10.8	5.4	2.0	2.7
182	5.7	3.5	2.0	3.5
183	16.6	8.5	1.0	2.0
184	7.1	4.0	1.0	1.8
185	5.4	4.9	1.9	2.0
186	7.3	5.8	1.7	2.3
187	6.7	2.6	1.1	3.7
188	8.7	4.7	1.6	2.6
189	11.5	5.7	1.6	2.6
190	2.7	2.5	3.1	3.3
191	12.3	6.4	1.1	1.7
192	15.0	9.3	1.1	1.8
193	5.2	4.0	1.4	1.9
194	3.7	2.5	2.5	3.5
195	9.5	3.9	1.3	2.6
196	14.1	2.2	0.7	4.6
197	23.1	3.3	0.7	5.1
198	19.2	1.8	0.7	5.2
199	17.1	3.7	0.9	4.0
200	8.2	2.5	1.3	3.9
201	20.4	3.8	0.8	3.7

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TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

<u>Compound No.</u>	<u>Leaf Diffusion Resistance (sec/cm)</u>		<u>Transpiration Rate (<math>\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}</math>)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
202	9.5	3.5	2.0	4.3
203	19.7	8.8	0.7	1.7
204	30.3	4.1	0.6	3.5
205	7.7	6.2	1.4	1.7
206	9.3	6.0	1.4	2.0
207	20.9	6.6	0.6	1.7
208	13.5	4.8	1.1	3.0
209	8.1	5.4	1.1	2.0
210	7.1	5.4	1.7	2.3
211	6.0 (c)	5.6	2.3 (c)	2.5
212	7.8 (b)	4.5	1.6 (b)	2.7
213	6.0 (b)	5.9	2.0 (b)	2.1
214	9.3	7.1	1.2	1.6
215	6.6	5.5	1.0	1.3
216	7.9	5.8	1.4	1.9
217	5.9	4.6	1.7	2.1
218	7.5	4.6	1.5	2.0
219	8.3	3.1	1.8	4.6
220	14.0	4.6	0.8	2.3
221	10.6	5.5	1.2	2.4
222	23.0	6.9	0.5	1.6
223	9.9	5.6	1.3	2.1
224	9.4	3.8	1.7	3.7

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TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

<u>Compound</u> <u>No.</u>	<u>Leaf Diffusion</u> <u>Resistance (sec/cm)</u>		<u>Transpiration Rate</u> <u>(<math>\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}</math>)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
225	6.7	5.7	2.4	3.1
226	9.6	6.9	1.7	2.2
227	8.4 (b)	6.7	1.8 (b)	2.3
228	31.1	5.7	0.5	2.3
229	25.0	3.6	0.4	2.5
230	25.1	6.7	0.5	1.6
231	5.9	2.1	1.9	4.3
232	6.9	3.8	2.8	4.0
233	11.8	4.2	1.6	4.4
234	15.4 (b)	3.7	0.9 (b)	3.3
235	12.6	3.1	1.0	4.0
236	6.7	5.3	1.7	2.1
237	21.8	2.6	0.7	5.1
238	3.7	2.6	2.9	3.9
239	25.1	2.6	0.8	4.4
240	11.4	5.5	1.3	2.7
241	11.2 (c)	3.6	1.3 (c)	3.5
242	11.5	2.1	1.3	6.2
243	18.3	5.6	0.6	1.8
244	11.5	2.9	0.4	1.4
245	10.8	3.4	1.4	3.9
246	11.4	3.0	1.1	3.9
247	10.4	2.6	1.5	5.2

TABLE AA (Cont.)  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

<u>Compound</u> <u>No.</u>	<u>Leaf Diffusion</u> <u>Resistance (sec/cm)</u>		<u>Transpiration Rate</u> <u>(<math>\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}</math>)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
248	3.8	2.5	1.1	1.6
249	3.1	2.8	3.9	4.3
250	2.6	1.9	6.0	8.2
251	3.3	2.8	3.8	4.1
252	5.1	4.1	2.3	2.9
253	3.3 (b)	2.7	3.5 (b)	4.1
254	5.4	4.2	1.5	2.0
255	5.0	3.8	2.0	2.9
256	4.3	2.2	3.2	5.5
257	28.8	3.9	0.5	3.4
258	2.9	2.7	4.0	4.7
259	14.2	4.7	0.7	1.9
260	30.1	2.9	0.4	3.2
261	10.4	3.2	0.4	1.2
262	17.8	2.8	0.5	3.6
263	10.2	3.3	0.4	1.2
264	22.8	4.6	0.6	2.7
265	3.7	2.6	2.5	3.5
266	14.3	5.7	1.2	2.9
267	12.0	4.1	1.0	2.4
268	6.1	2.6	3.2	6.7
269	11.3	6.9	1.7	2.6
270	19.5	6.4	0.9	2.6

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TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

<u>Compound</u> <u>No.</u>	<u>Leaf Diffusion</u> <u>Resistance (sec/cm)</u>		<u>Transpiration Rate</u> <u>(<math>\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}</math>)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
271	19.5 (c)	7.9	0.9 (c)	2.4
272	18.6	4.7	0.9	3.5
273	18.8	5.1	0.8	3.1
274	21.8	4.9	0.8	3.3
275	6.9	3.3	1.6	3.2
276	5.3	4.3	2.2	2.9
277	5.9 (c)	3.5	3.0 (c)	3.4
278	11.0	4.5	1.8	2.7
279	14.6	4.0	0.9	2.8
280	17.6	3.1	0.6	3.4
281	14.8	5.3	0.9	2.3
282	12.4	3.3	1.1	3.1
283	9.3	3.7	1.8	4.4
284	8.8 (d)	3.9	1.5 (d)	3.0
285	13.9	2.4	1.0	5.5
286	9.7	2.0	1.2	5.1
287	5.6	2.4	0.7	1.5
288	6.2	3.4	2.2	3.8
289	3.5	2.8	3.3	4.3
290	9.0	6.2	2.0	2.7
291	2.1	1.9	1.4	1.5
292	23.8 (b)	6.2	0.6 (b)	2.3
293	4.8 (c)	4.4	2.3 (c)	2.4

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TABLE AA (Cont.)

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on Leaf Diffusion  
Resistance and Transpiration Rate

<u>Compound No.</u>	<u>Leaf Diffusion Resistance (sec/cm)</u>		<u>Transpiration Rate (<math>\mu</math>g H<sub>2</sub>O/cm<sup>2</sup>. sec)</u>	
	<u>1840 ppm</u>	<u>Control</u>	<u>1840 ppm</u>	<u>Control</u>
294	31.5	9.3	0.5	1.8
295	28.3 (c)	7.5	0.5 (c)	1.4
296	27.6	6.7	0.5	2.0

- 
- (a) Treated at 115 parts per million.  
 (b) Treated at 230 parts per million.  
 (c) Treated at 460 parts per million.  
 (d) Treated at 920 parts per million.  
 (e) Treated at 3220 parts per million.

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The results in Table AA demonstrate that representative heterocyclic nitrogen-containing compounds used in the method of this invention significantly increase leaf diffusion resistance and decrease transpiration rate relative to untreated controls.

Example CLXXI

Water-Use Efficiency of  
Representative Heterocyclic  
Nitrogen-Containing Compounds

Water-use efficiency (WUE) is a determination of both the effectiveness of an antitranspirant compound, i.e., control of water usage by plants, and also the effect of such compound on plant growth, i.e., effect on plant photosynthesis. In particular, WUE is defined as the unit of plant dry matter produced per unit of water utilized for a given time period. As used in Tables BB through FF below, WUE was determined according to the following general procedure:

Solutions of the compounds identified in Tables BB through FF were prepared by dissolving 62.5 milligrams of the test compound into 5 milliliters of acetone. Two, one and 0.5 milliliters of this solution were placed into separate tubes, acetone was added to each tube to a total volume of 12 milliliters and water was then added to each tube to a final volume of 20 milliliters. Final concentrations of test compound in the above stock solutions were 1250 parts per million, 625 parts per million and 312 parts per million by weight. The other concentrations in parts of the test compound per million parts by weight of final solution employed in the tests described hereinbelow were obtained by appropriate dilutions of the stock solutions with water.



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Into 10.2 centimeter diameter plastic pots containing a potting soil, i.e., one-third sandy loam soil, one-third peat moss and one-third perlite by volume, were sown 12 milligrams of Kentucky bluegrass seeds or tall fescue turfgrass seeds. The plastic pots and potting soil were each weighed before sowing the seeds. The bluegrass and turfgrass were allowed to grow for a period of 8 to 12 weeks after planting and the height of the grasses was maintained at 2.5-3.8 centimeters during this period. Twelve hours prior to application of the test compounds identified in Tables O through S, the bluegrass and turfgrass were clipped to a uniform height of 2.5-3.8 centimeters, and the weight of each pot was obtained prior to treatment. Each concentration of the test compounds including the controls was applied by spraying to four pots (each pot sprayed with 5 milliliters of solution) by use of an aspirated spray apparatus set at 10 psig air pressure. As a control, a water-acetone solution containing no test compound was also applied to four pots. When dry, all of the pots were placed in a greenhouse at a temperature of  $80^{\circ}\text{F} \pm 5^{\circ}\text{F}$  and humidity of 50 percent  $\pm 5$  percent for a 7 day period with no watering. All pots were weighed every 24 hours and the amount of water utilized was determined by calculation using the daily weights and the initial weights. At the end of the 7 day period, visual observations were made of the grasses in all pots. The grasses were then clipped to a uniform height and the clippings were collected, dried and weighed for each pot.

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Water use was calculated using the following equation:

$$\text{Water use} = \frac{\text{grams of H}_2\text{O utilized by treated grasses}}{(\% \text{ of Control}) \text{ grams of H}_2\text{O utilized by untreated grasses (control)}}$$

WUE was calculated using the following equation:

$$\text{WUE} = \frac{\text{milligrams of dry weight of clippings}}{\text{grams of water utilized}}$$

The WUE was standardized to the control for each of the tests using the following equation:

$$\text{WUE Index} = \frac{\text{WUE for treated grasses}}{\text{WUE for untreated grasses (control)}}$$

The values obtained for each test compound concentration and control were averaged to obtain the results in Tables BB through FF.

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TABLE BB  
Water-Use Efficiency of Representative  
Heterocyclic Nitrogen-Containing  
Compounds on Kentucky Bluegrass

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(ppm)</u>	<u>Water Use</u> <u>(% of Control)</u>	<u>WUE</u>	<u>WUE Index</u>
Control	-	100	0.59	1.00
28	312	55	1.45	2.46
	625	57	2.04	3.46
	1250	54	2.59	4.39
30	312	62	1.25	2.12
	625	64	1.53	2.59
	1250	65	1.33	2.25
44	312	66	1.76	2.98
	625	48	2.40	4.07
	1250	35	4.05	6.86

TABLE CC  
Water-Use Efficiency of Representative  
Heterocyclic Nitrogen-Containing  
Compounds on Kentucky Bluegrass

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(ppm)</u>	<u>Water Use</u> <u>(% of Control)</u>	<u>WUE</u>	<u>WUE Index</u>
Control	-	100	0.78	1.00
Atrazine*	39	48	1.42	1.82
	78	36	1.34	1.72
	156	37	0.44	0.56
	312	36	0.31	0.40
26	312	63	2.49	3.19
	625	59	1.72	2.21
	1250	65	1.20	1.54
44	312	41	3.07	3.94
	625	39	3.56	4.56
	1250	36	3.51	4.50

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\*Grass damaged at all concentrations; nearly all grass dead at concentrations greater than 78 parts per million; substantial phytotoxicity.

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TABLE DD  
Water-Use Efficiency of Representative  
Heterocyclic Nitrogen-Containing  
Compounds on Kentucky Bluegrass

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(ppm)</u>	<u>Water Use</u> <u>(% of Control)</u>	<u>WUE</u>	<u>WUE Index</u>
Control	-	100	2.47	1.00
Atrazine*	10	65	2.87	1.03
	20	64	2.42	1.16
	39	65	2.65	0.98
32	312	89	2.65	1.07
	625	81	2.85	1.15
	1250	87	3.00	1.21
44	625	58	3.70	1.50
	938	52	4.38	1.77
	1250	49	3.94	1.59
64	312	86	2.54	1.03
	625	87	2.47	1.00
	1250	86	2.73	1.11

---

\*Grass damaged at all concentrations; substantial phytotoxicity.

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TABLE EE  
Water-Use Efficiency of Representative  
Heterocyclic Nitrogen-Containing  
Compounds on Kentucky Bluegrass

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(ppm)</u>	<u>Water Use</u> <u>(% of Control)</u>	<u>WUE</u>	<u>WUE Index</u>
Control	-	100	3.90	1.00
44	625	49.0	8.00	2.05
	938	41.3	12.0	3.08
54	312	63.9	7.00	1.79
	625	63.1	6.50	1.67

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TABLE FF  
Water-Use Efficiency of Representative  
Heterocyclic Nitrogen-Containing  
Compounds on Tall Fescue Turfgrass

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(ppm)</u>	<u>Water Use</u> <u>(% of Control)</u>	<u>WUE</u>	<u>WUE Index</u>
Control	-	100	0.74	1.00
Atrazine*	5	81	1.26	1.70
	10	83	1.09	1.47
	20	106	0.80	1.35
18	312	62	1.28	1.60
	625	61	2.02	2.73
	1250	57	1.75	2.36
44	625	78	1.56	2.11
	1250	54	2.04	2.76
101	312	96	1.77	2.39
	625	58	0.99	1.34
	1250	52	1.86	2.51

---

\*Grass damaged at all concentrations; substantial phytotoxicity.

The results in Tables BB through FF demonstrate that representative heterocyclic nitrogen-containing compounds used in the method of this invention significantly decrease water use relative to untreated controls with no negative effect on plant growth, i.e., no negative effect on plant photosynthesis. In contrast, the treatment of grasses with atrazine caused substantial phytotoxicity.



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Example CLXXII

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement - Corn

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Table GG below, crop yield enhancement was determined for corn according to the following general procedure:

Solutions of Compound 44 were prepared by dissolving either 0.78 grams, 1.55 grams or 3.10 grams of the compound into 780 milliliters of acetone. Just prior to the time of application, water was added to each of the above solutions to a final volume of 1300 milliliters. Solutions of a control having no test compound were also prepared by mixing 780 milliliters of acetone and 520 milliliters of water to a total volume of 1300 milliliters.

The above formulations were applied to corn by utilizing a statistical treatment procedure involving 42 separate plots. Each plot consisted of 4 rows individually 20 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the following: (1) treatment with control having no test compound; (2) treatment with 0.78 grams/plot of

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Compound 44 at time  $T_1$  designated in Table GG; (3) treatment with 1.55 grams/plot of Compound 44 at time  $T_1$  designated in Table GG; (4) treatment with 3.10 grams/plot of Compound 44 at time  $T_1$  designated in Table GG; (5) treatment with 0.78 grams/plot of Compound 44 at time  $T_2$  designated in Table GG; (6) treatment with 1.55 grams/plot of Compound 44 at time  $T_2$  designated in Table GG; and (7) treatment with 3.10 grams/plot of Compound 44 at time  $T_2$  designated in Table GG. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for the corn crop are detailed in Table GG. The harvested corn crop for yield determination included the inner 10 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table GG.

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TABLE GG  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement-Corn

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(gm/plot)</u>	<u>Application Timing*</u>	<u>Actual Yield</u> <u>(kg/plot)</u>
Control	-	-	9.87
44	0.78	Tassel ( $T_1$ )	10.71
	1.55	Tassel ( $T_1$ )	10.62
	3.10	Tassel ( $T_1$ )	10.39
44	0.78	3 Weeks after Tassel ( $T_2$ )	11.17
	1.55	3 Weeks after Tassel ( $T_2$ )	11.18
	3.10	3 Weeks after Tassel ( $T_2$ )	10.30

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\*First application at tassel ( $T_1$ ), 46 days after planting; second application at 3 weeks after tassel ( $T_2$ ), 67 days after planting; and harvesting occurred 114 days after planting.

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The results in Table GG demonstrate that treatment of corn with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases corn crop yield in comparison with untreated control corn crops at similar conditions.

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Example CLXXIII  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement - Cotton

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Table HH below, crop yield enhancement was determined for cotton according to the following general procedure:

Solutions of Compound 44 were prepared by dissolving either 0.78 grams, 1.55 grams or 3.10 grams of the compound into 780 milliliters of acetone. Just prior to the time of application, water was added to each of the above solutions to a final volume of 1300 milliliters. Solutions of a control having no test compound were also prepared by mixing 780 milliliters of acetone and 520 milliliters of water to a total volume of 1300 milliliters.

The above formulations were applied to cotton by utilizing a statistical treatment procedure involving 36 separate plots. Each plot consisted of 4 rows individually 20 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the following: (1) treatment with control having no test compound; (2) treatment with 0.78

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grams/plot of Compound 44 at time  $T_1$  designated in Table HH; (3) treatment with 1.55 grams/plot of Compound 44 at time  $T_1$  designated in Table HH; (4) treatment with 3.10 grams/plot of Compound 44 at time  $T_1$  designated in Table HH; (5) treatment with 0.78 grams/plot of Compound 44 at time  $T_2$  designated in Table HH; and (6) treatment with 3.10 grams/plot of Compound 44 at time  $T_2$  designated in Table HH. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for the cotton crop are detailed in Table HH. The harvested cotton crop for yield determination included the inner 10 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table HH.

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TABLE HH  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement-Cotton

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(gm/plot)</u>	<u>Application Timing*</u>	<u>Actual Yield</u> <u>(gm/plot)</u>
Control	-	-	984.5
44	0.78	Bloom ( $T_1$ )	1081.0
	1.55	Bloom ( $T_1$ )	1160.4
	3.10	Bloom ( $T_1$ )	1175.3
44	0.78	3 Weeks after Bloom ( $T_2$ )	1057.8
	3.10	3 Weeks after Bloom ( $T_2$ )	1065.1

---

\*First application at bloom ( $T_1$ ), 47 days after planting; second application at 3 weeks after bloom ( $T_2$ ), 67 days after planting; and harvesting occurred 126 days after planting.

The results in Table HH demonstrate that treatment of cotton with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases cotton crop yield in comparison with untreated control cotton crops at similar conditions.



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Example CLXXIV

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement - Sweet Potatoes

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Table II below, crop yield enhancement was determined for sweet potatoes according to the following general procedure:

Solutions of Compound 44 were prepared by dissolving either 0.78 grams, 1.55 grams or 3.10 grams of the compound into 780 milliliters of acetone. Just prior to the time of application, water was added to each of the above solutions to a final volume of 1300 milliliters. Solutions of a control having no test compound were also prepared by mixing 780 milliliters of acetone and 520 milliliters of water to a total volume of 1300 milliliters.

The above formulations were applied to sweet potatoes by utilizing a statistical treatment procedure involving separate plots. Each plot consisted of 4 rows individually 20 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the following: (1) treatment with control having no test compound; (2) treatment with 0.78

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grams/plot of Compound 44 at time  $T_1$  designated in Table II; (3) treatment with 1.55 grams/plot of Compound 44 at time  $T_1$  designated in Table II; (4) treatment with 3.10 grams/plot of Compound 44 at time  $T_1$  designated in Table II; (5) treatment with 0.78 grams/plot of Compound 44 at time  $T_2$  designated in Table II; and (6) treatment with 1.55 grams/plot of Compound 44 at time  $T_2$  designated in Table II. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for the sweet potato crop are detailed in Table II. The harvested sweet potato crops for yield determination included the inner 10 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table II.

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TABLE II  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement-Sweet Potatoes

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(gm/plot)</u>	<u>Application Timing*</u>	<u>Actual Yield</u> <u>(kg/plot)</u>
Control	-	-	95.48
44	0.78	Tuber Initiation ( $T_1$ )	111.10
	1.55	Tuber Initiation ( $T_1$ )	99.88
	3.10	Tuber Initiation ( $T_1$ )	99.88
44	0.78	4 Weeks after Tuber Initiation ( $T_2$ )	107.36
	1.55	4 Weeks after Tuber Initiation ( $T_2$ )	98.78

---

\*First application at tuber initiation ( $T_1$ ), 43 days after transplanting; second application at 4 weeks after tuber initiation ( $T_2$ ), 77 days after transplanting; and harvesting occurred 140 days after transplanting.

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The results in Table II demonstrate that treatment of sweet potatoes with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases sweet potatoe crop yield in comparison with untreated control sweet potatoe crops at similar conditions.

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Example CLXXV  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement - Soybeans

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Table JJ below, crop yield enhancement was determined for soybeans according to the following general procedure:

Solutions of Compound 44 were prepared by dissolving either 0.78 grams, 1.55 grams or 3.10 grams of the compound into 780 milliliters of acetone. Just prior to the time of application, water was added to each of the above solutions to a final volume of 1300 milliliters. Solutions of a control having no test compound were also prepared by mixing 780 milliliters of acetone and 520 milliliters of water to a total volume of 1300 milliliters.

The above formulations were applied to soybeans by utilizing a statistical treatment procedure involving 36 separate plots. Each plot consisted of 4 rows individually 20 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the following: (1) treatment with control having no test compound; (2) treatment with 1.55

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grams/plot of Compound 44 at time  $T_1$  designated in Table JJ; (3) treatment with 3.10 grams/plot of Compound 44 at time  $T_1$  designated in Table JJ; (4) treatment with 0.78 grams/plot of Compound 44 at time  $T_2$  designated in Table JJ; (5) treatment with 1.55 grams/plot of Compound 44 at time  $T_2$  designated in Table JJ; and (6) treatment with 3.10 grams/plot of Compound 44 at time  $T_2$  designated in Table JJ. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for the soybean crop are detailed in Table JJ. The harvested soybean crop for yield determination included the inner 10 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table JJ.

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TABLE JJ  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement-Soybeans

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(gm/plot)</u>	<u>Application Timing*</u>	<u>Actual Yield</u> <u>(kg/plot)</u>
Control	-	-	0.48
44	1.55	Flowering ( $T_1$ )	0.55
	3.10	Flowering ( $T_1$ )	0.55
44	0.78	3 Weeks after Flowering ( $T_2$ )	0.58
	1.55	3 Weeks after Flowering ( $T_2$ )	0.60
	3.10	3 Weeks after Flowering ( $T_2$ )	0.52

---

\*First application at flowering ( $T_1$ ), 63 days after planting;  
second application at 3 weeks after flowering ( $T_2$ ), 86 days after  
planting; and harvesting occurred 201 days after planting.

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The results in Table JJ demonstrate that treatment of soybeans with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases soybean crop yield in comparison with untreated control soybean crops at similar conditions.



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Example CLXXVIEffect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement - Cotton and Potatoes

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Tables KK and LL below, crop yield enhancement was determined for cotton and potatoes according to the following general procedure:

An emulsifiable concentrate of Compound 44 was prepared containing 39.3 weight percent of propylene carbonate, 39.3 weight percent of Exxate 700 (Exxon Chemicals, Houston, Texas), 10.0 weight percent of Atlox 3455F (ICI Americas, Wilmington, Delaware) and 11.4 weight percent of Compound 44. Just prior to the time of application, 31 milliliters (3.5 grams of Compound 44) or 62 milliliters (7.0 grams of Compound 44) of the above emulsifiable concentrate was added to water to a final volume of 3125 milliliters.

The above formulations were applied to the particular crop designated in Tables KK and LL by utilizing a statistical treatment procedure involving 30 separate plots. Each plot consisted of 4 rows individually 30 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the

following: (1) treatment with control having no test compound; (2) treatment with 3.5 grams/plot of Compound 44 at time  $T_1$  designated in Table KK and LL; (3) treatment with 7.0 grams/plot of Compound 44 at time  $T_1$  designated in Tables KK and LL; (4) treatment with 3.5 grams/plot of Compound 44 at time  $T_2$  designated in Tables KK and LL; and (5) treatment with 7.0 grams/plot of Compound 44 at time  $T_2$  designated in Tables KK and LL. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for each crop are detailed in Tables KK and LL. The harvested crops for yield determination included the inner 20 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Tables KK and LL.

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TABLE KK  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement-Cotton

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(gm/plot)</u>	<u>Application Timing*</u>	<u>Actual Yield</u> <u>(kg/plot)</u>
Control	-	-	3.18
44	3.5	Two weeks before Bloom ( $T_1$ )	3.49
	7.0	Two weeks before Bloom ( $T_1$ )	3.48
44	3.5	Bloom ( $T_2$ )	3.61
	7.0	Bloom ( $T_2$ )	3.35

---

\*First application at two weeks before bloom ( $T_1$ ), 61 days after planting; second application at bloom ( $T_2$ ), 73 days after planting; and harvesting occurred 167 days after planting.

TABLE LL  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement-Potatoes

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(gm/plot)</u>	<u>Application Timing*</u>	<u>Actual Yield</u> <u>(kg/plot)</u>
Control	-	-	9.01
44	3.5	Flowering ( $T_1$ )	10.94
	7.0	Flowering ( $T_1$ )	10.23
44	3.5	3 Weeks after Flowering ( $T_2$ )	10.30
	7.0	3 Weeks after Flowering ( $T_2$ )	9.87

---

\*First application at flowering ( $T_1$ ), 75 days after planting;  
second application at 3 weeks after flowering ( $T_2$ ), 96 days after  
planting; and harvesting occurred 125 days after planting.

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The results in Tables KK and LL demonstrate that treatment of cotton and potatoes with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases crop yield in comparison with untreated control crops at similar conditions.

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Example CLXXVII  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement - Soybeans

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Table MM below, crop yield enhancement was determined for soybeans according to the following general procedure:

An emulsifiable concentrate of Compound 44 was prepared containing 39.3 weight percent of propylene carbonate, 39.3 weight percent of Exxate 700 (Exxon Chemicals, Houston, Texas), 10.0 weight percent of Atlox 3455F (ICI Americas, Wilmington, Delaware) and 11.4 weight percent of Compound 44. Just prior to the time of application, 31 milliliters (3.5 grams Compound 44) or 62 milliliters (7.0 grams Compound 44) of the above emulsifiable concentrate was added to water to a final volume of 3125 milliliters.

The above formulations were applied to the soybeans by utilizing a statistical treatment procedure involving 18 separate plots. Each plot consisted of 4 rows individually 30 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the following: (1) treatment with control

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having no test compound; (2) treatment with 3.5 grams/plot of Compound 44 at time  $T_1$  designated in Table MM; and (3) treatment with 7.0 grams/plot of Compound 44 at time  $T_1$  designated in Table MM. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for the soybean crop are detailed in Table MM. The harvested soybean crop for yield determination included the inner 20 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table MM.

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TABLE MM  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement-Soybeans

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>(gm/plot)</u>	<u>Application Timing*</u>	<u>Actual Yield</u> <u>(kg/plot)</u>
Control	-	-	6.29
44	3.5	Flowering ( $T_1$ )	6.87
	7.0	Flowering ( $T_1$ )	6.50

---

\*First application at flowering ( $T_1$ ), 48 days after planting; and harvesting occurred 186 days after planting.



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The results in Table MM demonstrate that treatment of soybeans with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases soybean crop yield in comparison with untreated control soybean crops at similar conditions.

Example CLXXVIII

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement - Alfalfa

The effect of representative heterocyclic nitrogen-containing compounds on crop yield enhancement was also determined for alfalfa according to the following general procedure:

Solutions of Compound 44 were prepared by dissolving either 6.60 grams or 13.20 grams of the compound into 3300 milliliters of acetone. Just prior to the time of application, water was added to each of the above solutions to a final volume of 5500 milliliters. Solutions of a control having no test compound were also prepared by mixing 3300 milliliters of acetone and 2200 milliliters of water to a total volume of 5500 milliliters.

The above formulations were applied to designated plots of one year old established alfalfa crop by utilizing a self-propelled chemical spray applicator set at 40 psig air pressure. Each plot had the following dimensions: 20 feet in width by 30 feet in length. Each treatment including the controls consisted of 6 replications on 6 separate plots. The above formulations were applied 20 days following a cutting and the alfalfa was harvested 28 days following the treatment. The harvested alfalfa crop for yield determination included a one square meter area from the center of each plot. Water stress conditions existed to a degree during at

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least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table NN below.

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TABLE NN  
Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Crop Yield Enhancement-Alfalfa

Compound No.	Concentration (gm/plot)	Actual Yield	
		Fresh Weight* (gm/m <sup>2</sup> )	Dry Weight** (gm/m <sup>2</sup> )
Control	-	301.2	128.2
44	6.60	331.2	146.7
	13.20	342.8	153.2

\*Fresh weight was determined by weighing the alfalfa immediately after harvest.

\*\*Dry weight was determined by drying the harvested alfalfa in an oven at 90°C for 24 hours and then weighing the dried alfalfa.

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The results in Table NN demonstrate that treatment of alfalfa with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases alfalfa crop yield in comparison with untreated control alfalfa crops.

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Example CLXXIXEffect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Photosynthetic Electron Transport

Because the two photosystems, i.e., Photosystems I and II, involved in plant photosynthesis are interconnected by an electron transport chain, the use of artificial electron donors and acceptors allows the study of specific partial reactions of the light reactions of photosynthesis. In accordance with the procedure described in Brewer, P.E., Arntzen, C.J., and Slife, F.W., Weed Science 27: 300-308 (1979), an isolated chloroplast assay was used to determine the degree of photosynthetic inhibition caused by the compounds identified in Table OO. In general, the procedure involved osmotically disrupting isolated pea chloroplasts, placing the chloroplasts in a reaction mixture and utilizing methylviologen as the terminal electron acceptor. Oxygen consumption was measured using a Clark electrode attached to a Gilson auxograph. The results in Table OO are reported as percent inhibition compared to an untreated control.

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TABLE 00

Effect of Representative Heterocyclic  
Nitrogen-Containing Compounds on  
Photosynthetic Electron Transport

<u>Compound</u> <u>No.</u>	<u>Concentration</u> <u>( g/liter)</u>	<u>Percent Inhibition</u> <u>( Oxygen Uptake)</u>
Control	0	0
44	622	0
93	650	0
Atrazine	108	65
Diuron	47	55

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The results in Table OO demonstrate that compounds used in this invention cause no inhibition of photosynthetic electron transport whereas atrazine and diuron both cause substantial inhibition of photosynthetic electron transport.



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Although the invention has been illustrated by the preceding examples, it is not to be construed as being limited thereby; but rather, the invention encompasses the generic area as hereinbefore disclosed. Various modifications and embodiments can be made without departing from the spirit and scope thereof.

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Claims

1. A method of reducing moisture loss from plants which comprises applying to the plant surface an effective amount, sufficient to reduce moisture loss from the plant surface without substantially inhibiting plant photosynthetic electron transport, of a compound having the formula:



wherein:

$R_1$  is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryl dialkylsilyloxy, triaryl silyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl,

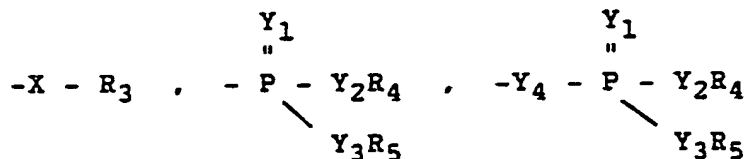
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polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio,

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alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>.



or



R<sub>1</sub> is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl,

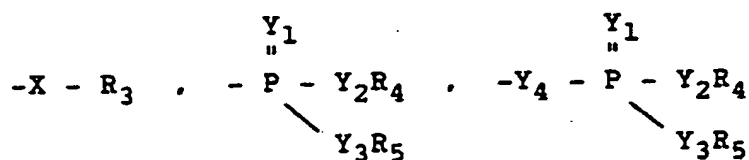
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alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkyryl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide,

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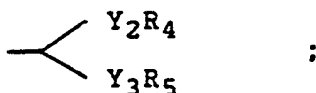
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
 aryloxy, aralkoxy, arylthio, aralkylthio,  
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>.



or

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X is a covalent single bond or double bond, a substituted or unsubstituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl,

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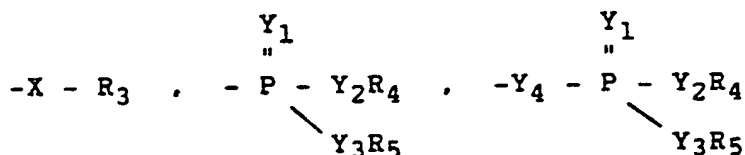
aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl,



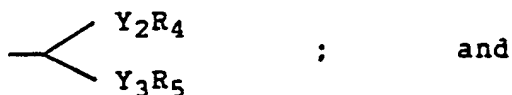
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alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



$R_2$  is a substituted or unsubstituted, heterocyclic ring system having at least one nitrogen atom which is selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl,

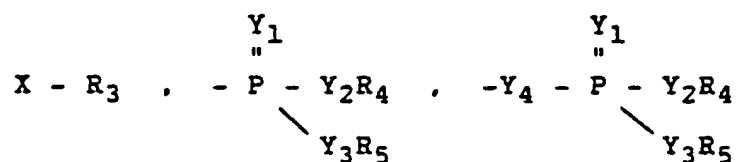
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dialkylaminocarbonyl, aminothiocarbonyl,  
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
nitro, cyano, hydroxycarbonyl and derivative salts  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,

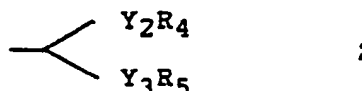
- 589 -

aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxylalkylphosphinyl,  
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxylphosphino, hydroxyamino, alkoxylamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,  
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



wherein:

$R_3$  is a substituted or unsubstituted,  
 carbocyclic or heterocyclic ring system selected  
 from a monocyclic aromatic or nonaromatic ring

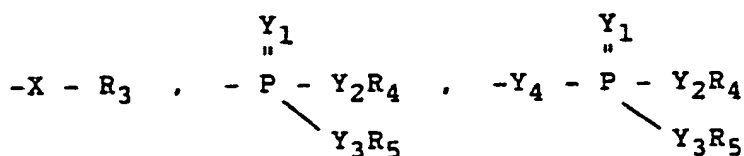
- 590 -

system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,

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polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

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$$-X, = X, -X = R_3, = X-R_3,$$


or



$R_3$  is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio,

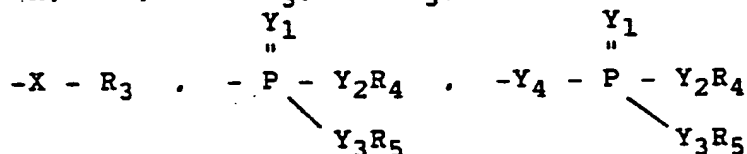
- 593 -

alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy,

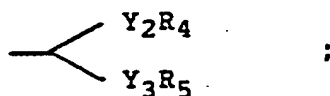
- 594 -

arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X = X$ ,  $-X = R_3$ ,  $= X-R_3$ ,



or



$Y_1$  and  $Y_4$  are independently oxygen or sulfur;

$Y_2$  and  $Y_3$  are independently oxygen, sulfur, amino or a covalent bond; and

$R_4$  and  $R_5$  are independently hydrogen or substituted or unsubstituted alkyl, polyhaloalkyl, phenyl or benzyl in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxyalkonylalkyl, alkoxyalkonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy,



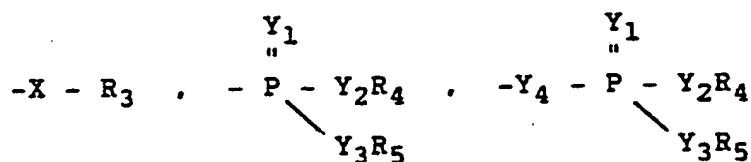
- 595 -

triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl,

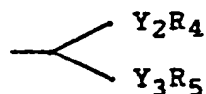
- 596 -

arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>.

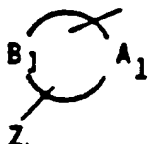


or

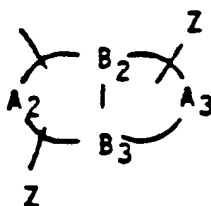


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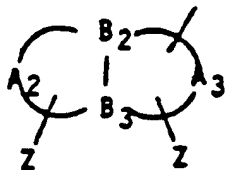
2. The method of claim 1 wherein  $R_1$  and  $R_3$  are independently a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system having the formula



a bicyclic aromatic or nonaromatic ring system having the formula selected from

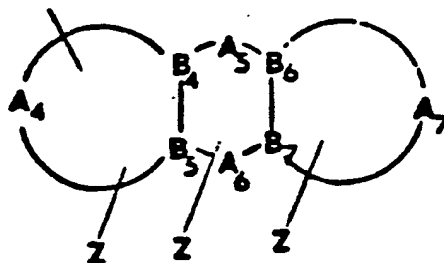
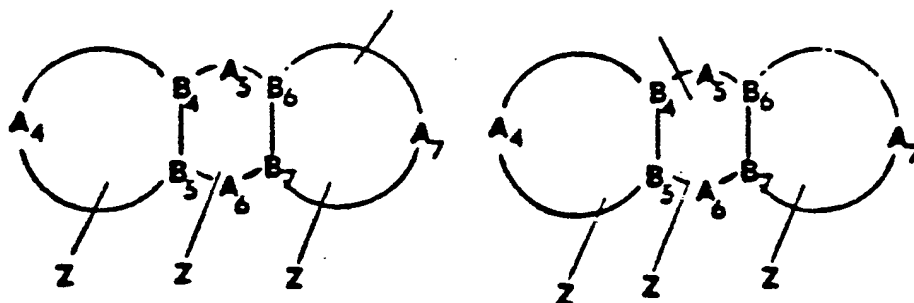


and

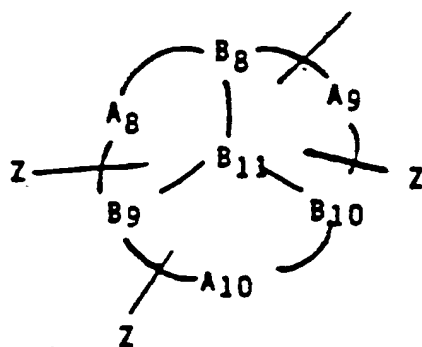


a polycyclic aromatic or nonaromatic ring system having the formula selected from

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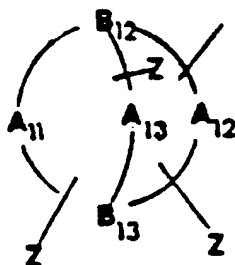
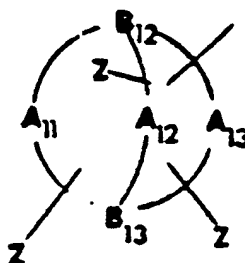


and

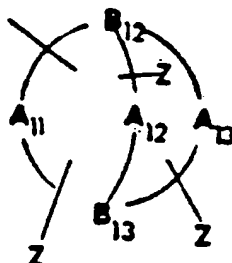


and a bridged ring system which may be saturated or unsaturated having the formula selected from

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and



wherein:

$A_1$  represents a ring-forming chain of atoms which together with  $B_1$  forms a carbocyclic or heterocyclic ring system containing from 0 to 4 double bonds or from 0 to 2 triple bonds;

$B_1$  represents a saturated or unsaturated carbon atom;

$A_2$  and  $A_3$  independently represent a ring-forming chain of atoms which together with  $B_2$  and  $B_3$  form a carbocyclic or heterocyclic ring system;

$B_2$  and  $B_3$  are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

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A<sub>4</sub>, A<sub>5</sub>, A<sub>6</sub> and A<sub>7</sub> independently represent a ring-forming chain of atoms which together with B<sub>4</sub>, B<sub>5</sub>, B<sub>6</sub> and B<sub>7</sub> form a carbocyclic or heterocyclic ring system;

B<sub>4</sub>, B<sub>5</sub>, B<sub>6</sub> and B<sub>7</sub> are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

A<sub>8</sub>, A<sub>9</sub> and A<sub>10</sub> independently represent a ring-forming chain of atoms which together with B<sub>8</sub>, B<sub>9</sub>, B<sub>10</sub> and B<sub>11</sub> form a carbocyclic or heterocyclic ring system;

B<sub>8</sub>, B<sub>9</sub> and B<sub>10</sub> are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

B<sub>11</sub> represents a saturated or unsaturated carbon atom, nitrogen atom or phosphorous atom;

A<sub>11</sub>, A<sub>12</sub> and A<sub>13</sub> independently represent a ring-forming chain of atoms which together with B<sub>12</sub> and B<sub>13</sub> form a carbocyclic or heterocyclic ring system;

B<sub>12</sub> and B<sub>13</sub> are independently a saturated carbon atom or a nitrogen atom; and

Z is the same or different and is one or more of hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl,

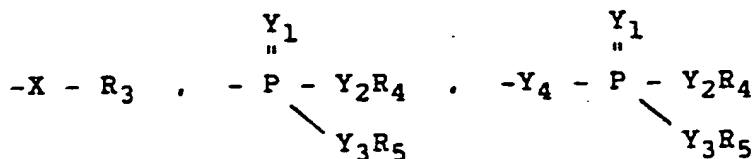
- 601 -

dialkylaminocarbonyl, aminothiocarbonyl,  
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
nitro, cyano, hydroxycarbonyl and derivative salts  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,

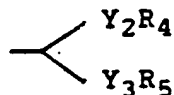
- 602 -

aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>.



or

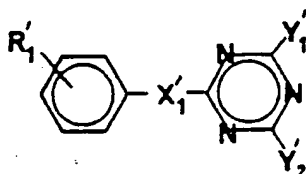


wherein R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub>, Y<sub>4</sub> and X are as defined in claim 1.



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3. The method of claim 1 in which the compound has the formula



wherein:

R'<sub>1</sub> is the same or different and is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio.

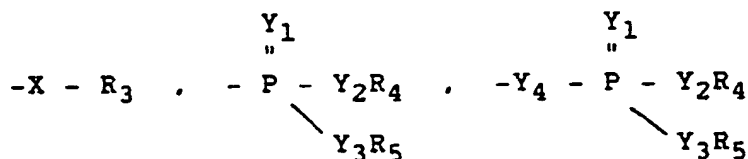
- 604 -

alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,

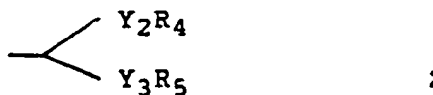
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arylsulfonamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



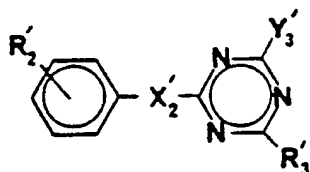
$X'_1$  is O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a single covalent bond, CH<sub>2</sub>O, CH<sub>2</sub>S, -CH(CH<sub>3</sub>)O, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-; and

$Y'_1$  and  $Y'_2$  are independently halogen, alkyl or alkoxy;

wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub> and Y<sub>4</sub> are as defined in claim 1.

4. The method of claim 1 in which the compound has the formula

- 606 -



wherein:

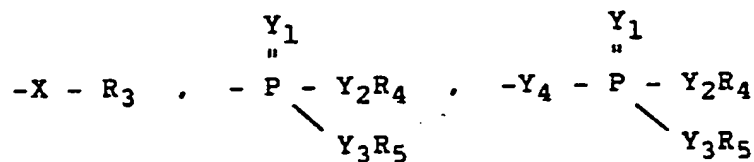
R'<sub>2</sub> and R'<sub>3</sub> are the same or different and R'<sub>2</sub> is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl,

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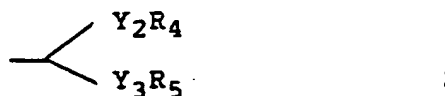
aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl,

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alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,  
 $-X, = X, -X = R_3, = X-R_3,$



or

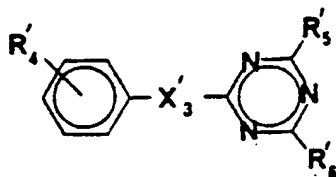


$X'_2$  is O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a  
 single covalent bond, -CH(CH<sub>3</sub>)O-, -CH(CN)O-,  
 -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-,  
 -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)-  
 or -CONH-; and

$Y'_3$  is halogen;

wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub> and  
 Y<sub>4</sub> are as defined in claim 1.

5. The method of claim 1 in which the  
 compound has the formula



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wherein:

R'<sub>4</sub>, R'<sub>5</sub> and R'<sub>6</sub> are the same or different and R'<sub>4</sub> is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxy carbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,

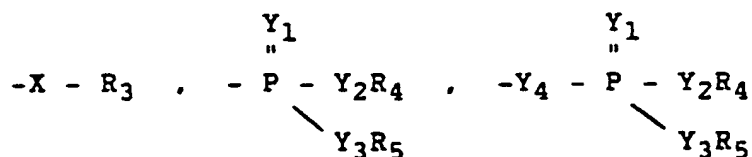
- 610 -

polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyposphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,



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$-X, = X, -X = R_3, = X-R_3,$



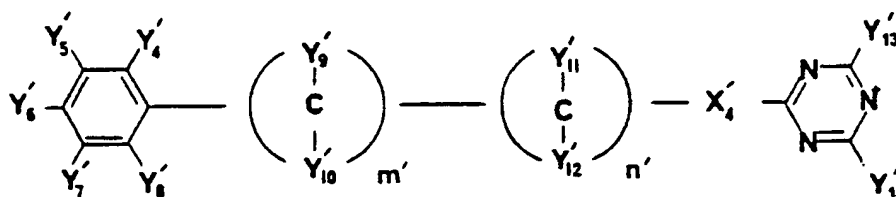
or



$X'_3$  is O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a single covalent bond, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-;

wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub> and Y<sub>4</sub> are as defined in claim 1.

6. The method of claim 1 in which the compound has the formula



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wherein:

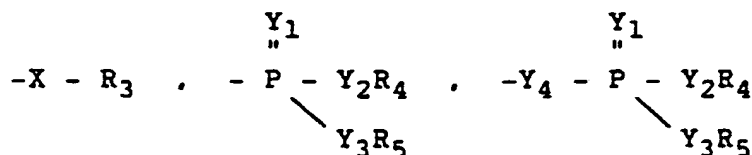
Y'<sub>4</sub>, Y'<sub>5</sub>, Y'<sub>6</sub>, Y'<sub>7</sub> and Y'<sub>8</sub> are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,

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alkoxyiminomethyl, unsubstituted or substituted  
 aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
 or substituted arylhydrazonomethyl, a hydroxy group  
 condensed with a mono-, di- or polysaccharide,  
 haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
 aryloxy, aralkoxy, arylthio, aralkylthio,  
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X,  $\equiv$  X, -X = R<sub>3</sub>,  $\equiv$  X-R<sub>3</sub>.

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or



$Y'_9$ ,  $Y'_{10}$ ,  $Y'_{11}$  and  $Y'_{12}$  are the same or different and are hydrogen, halogen, alkyl, polyhaloalkyl, cyano or aryl;

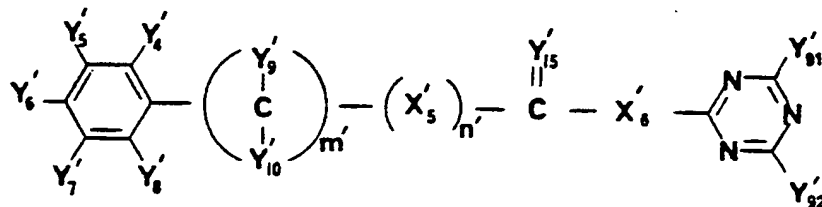
$m'$  and  $n'$  are the same or different and are a value of from 0 to 5;

$X'_4$  is O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a single covalent bond, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-; and

$Y'_{13}$  and  $Y'_{14}$  are the same or different and are halogen, alkyl or alkoxy;

wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub> and Y<sub>4</sub> are as defined in claim 1.

7. The method of claim 1 in which the compound has the formula



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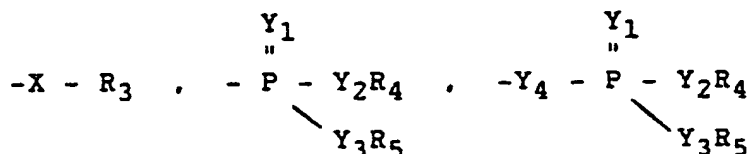
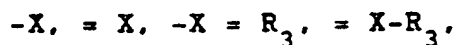
wherein:

Y'<sub>4</sub>, Y'<sub>5</sub>, Y'<sub>6</sub>, Y'<sub>7</sub> and Y'<sub>8</sub> are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,

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polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

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or



$Y'_9$  and  $Y'_{10}$  are the same or different and are hydrogen, halogen, alkyl, polyhaloalkyl, cyano or aryl;

$m'$  and  $n'$  are the same or different and are a value of from 0 to 5;

$X'_5$  is the same or different and is O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a single covalent bond, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-;

$Y'_{15}$  is O or S;

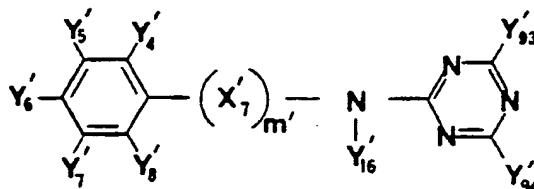
$Y'_{91}$  and  $Y'_{92}$  are independently halogen; and

$X'_6$  is O or S;

wherein  $X$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $Y_1$ ,  $Y_2$ ,  $Y_3$  and  $Y_4$  are as defined in claim 1.

8. The method of claim 1 in which the compound has the formula

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wherein:

Y'<sub>4</sub>, Y'<sub>5</sub>, Y'<sub>6</sub>, Y'<sub>7</sub> and Y'<sub>8</sub> are the same as different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino,



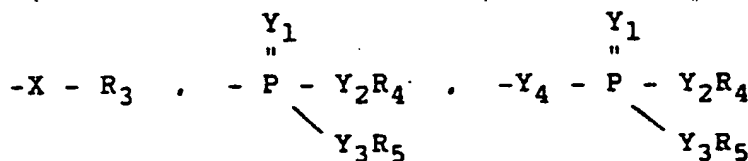
- 619 -

alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino,

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trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>,



or



X'<sub>7</sub> is the same or different and is O, S,  
 SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a single covalent bond,  
 -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-,  
 -CH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-,  
 -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-;

m' is a value of from 0 to 5;

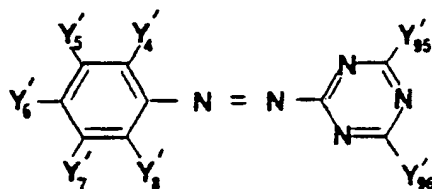
Y'<sub>16</sub> is hydrogen, alkyl, alkylcarbonyl,  
 alkylsulfonyl, or polyhaloalkylsulfonyl; and

Y'<sub>93</sub> and Y'<sub>94</sub> are independently halogen;

wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub> and  
 Y<sub>4</sub> are as defined in claim 1.

9. The method of claim 1 in which the  
 compound has the formula

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wherein:

$Y'_4$ ,  $Y'_5$ ,  $Y'_6$ ,  $Y'_7$  and  $Y'_8$  are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryl dialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino,

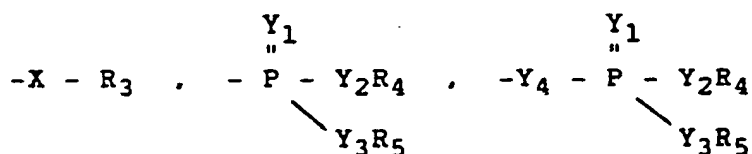
- 622 -

alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino,

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trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

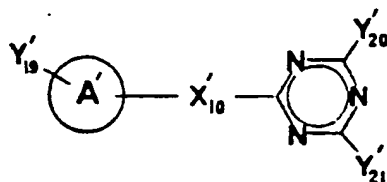


or



$Y'_{95}$  and  $Y'_{96}$  are independently halogen;  
 wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$  and  
 $Y_4$  are as defined in claim 1.

10. The method of claim 1 in which the  
 compound has the formula



wherein:

$Y'_{19}$  and  $Y'_{21}$  are the same or different  
 and  $Y'_{19}$  is one or more hydrogen, halogen,  
 alkylcarbonyl, alkylcarbonylalkyl,

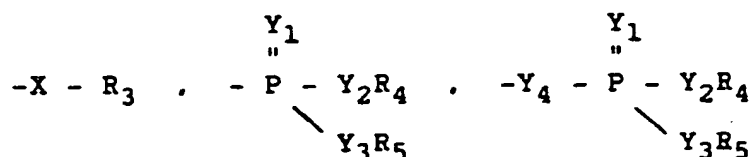
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alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide,

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haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
 aryloxy, aralkoxy, arylthio, aralkylthio,  
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium.

$-X, = X, -X = R_3, = X-R_3,$



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or



A' is as defined for R<sub>1</sub> in claim 1;

X'<sub>10</sub> is as defined for X in claim 1; and

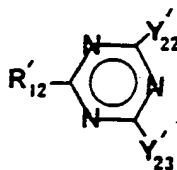
Y'<sub>20</sub> is halogen, cyano, alkyl, alkoxy,

polyhaloalkyl, polyhaloalkoxy, or

polyhaloalkylsulfonyloxy;

wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub> and Y<sub>4</sub> are as defined in claim 1.

11. The method of claim 1 in which the compound has the formula



wherein:

R'<sub>12</sub> is as defined for R<sub>1</sub> in claim 1;

Y'<sub>22</sub> is halogen, cyano, alkyl, alkoxy,

polyhaloalkyl, polyhaloalkoxy, or

polyhaloalkylsulfonyloxy; and

Y'<sub>23</sub> is hydrogen, halogen, alkylcarbonyl,

alkylcarbonylalkyl, alkoxycarbonylalkyl,

alkoxycarbonylalkylthio, polyhaloalkenylthio,

thiocyano, propargylthio, hydroxyimino, alkoxyimino,

trialkylsilyloxy, aryldialkylsilyloxy,

triarylsilyloxy, formamidino, alkylsulfamido,

dialkylsulfamido, alkoxysulfonyl,

polyhaloalkoxysulfonyl, hydroxy, amino,

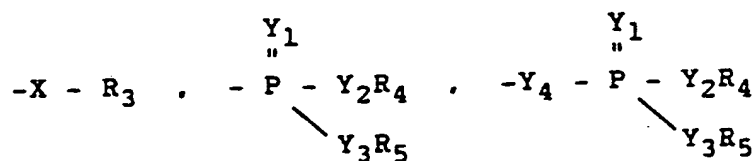


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aminocarbonyl, alkylaminocarbonyl,  
dialkylaminocarbonyl, aminothiocarbonyl,  
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
nitro, cyano, hydroxycarbonyl and derivative salts  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,

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alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,  
 $-X, = X, -X = R_3, = X-R_3$ .



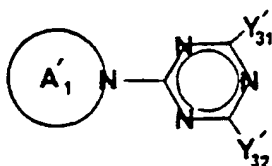
or



wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$  and  $Y_4$  are as defined in claim 1.

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12. The method of claim 1 in which the compound has the formula



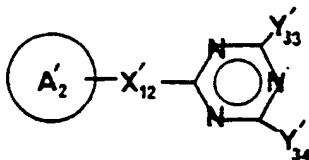
wherein:

$A'_1$  is as defined for  $R_2$  in claim 1;

and

$Y'_{31}$  and  $Y'_{32}$  are the same or different and are halogen, alkyl or alkoxy.

13. The method of claim 1 in which the compound has the formula



wherein:

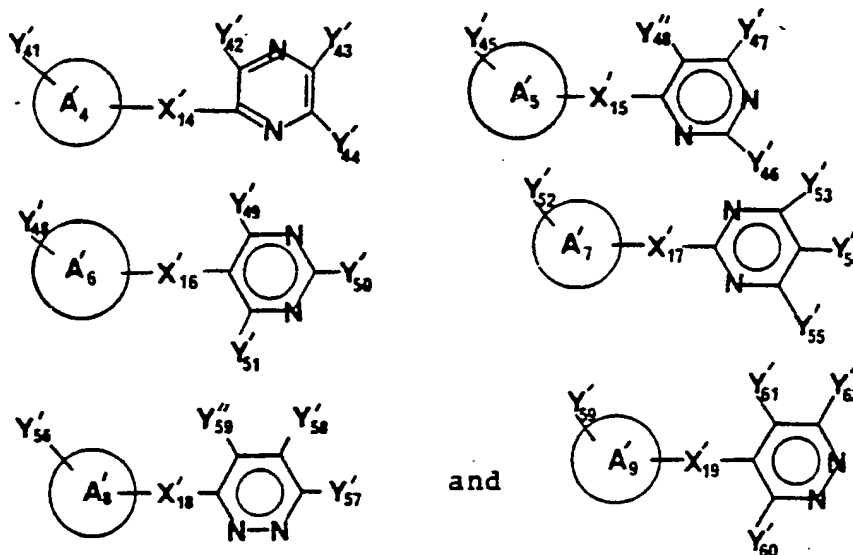
$A'_2$  is as defined for  $R_1$  in claim 1;

$X'_{12}$  is as defined for  $X$  in claim 1; and

$Y'_{33}$  and  $Y'_{34}$  are the same or different and are halogen, alkyl or alkoxy.

14. The method of claim 1 in which the compound has the formula selected from

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wherein:

Y'41, Y'42, Y'43, Y'44, Y'45,  
 Y'46, Y'47, Y'48, Y'49, Y'50, Y'51,  
 Y'52, Y'53, Y'54, Y'55, Y'56,  
 Y'57, Y'58, Y'59, Y'60, Y'61, and  
 Y'62 are the same or different and Y'41, Y'45,  
 Y'48, Y'52, Y'56, and Y'59 are one or more  
 hydrogen, halogen, alkylcarbonyl,  
 alkylcarbonylalkyl, alkoxycarbonylalkyl,  
 alkoxycarbonylalkylthio, polyhaloalkenylthio,  
 thiocyno, propargylthio, hydroxyimino, alkoxyimino,  
 trialkylsilyloxy, aryldialkylsilyloxy,  
 triarylsilyloxy, formamidino, alkylsulfamido,  
 dialkylsulfamido, alkoxysulfonyl,  
 polyhaloalkoxysulfonyl, hydroxy, amino,  
 aminocarbonyl, alkylaminocarbonyl,  
 dialkylaminocarbonyl, aminothiocabonyl,  
 alkylaminothiocabonyl, dialkylaminothiocabonyl,  
 nitro, cyano, hydroxycarbonyl and derivative salts  
 formamido, alkyl, alkoxy, polyhaloalkyl,  
 polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
 which the permissible substituents are the same or

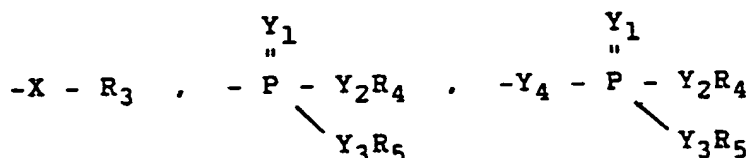
- 631 -

different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy.

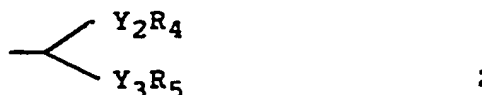
- 632 -

alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



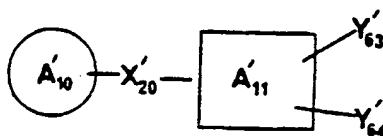
$A'_4, A'_5, A'_6, A'_7, A'_8$  and  $A'_9$   
 are as defined for  $R_1$  in claim 1; and

$X'_{14}, X'_{15}, X'_{16}, X'_{17}, X'_{18}$  and  
 $X'_{19}$  are the same or different and are O, S, SO,  
 $SO_2$ , NH,  $CH_2$ , CO, a single covalent bond,  
 $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  
 $-CH_2CH_2O-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2$ ,  
 $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$  or  $-CONH-$ ;

wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$ , and  
 $Y_4$  are as defined in claim 1.

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15. The method of claim 1 in which the compound has the formula



wherein:

$A'_{10}$  is as defined for  $R_1$  in claim 1;  
 $X'_{20}$  is as defined for  $X$  in claim 1;  
 $A'_{11}$  is a substituted or unsubstituted, 5-membered heterocyclic ring system having at least one nitrogen atom in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl,

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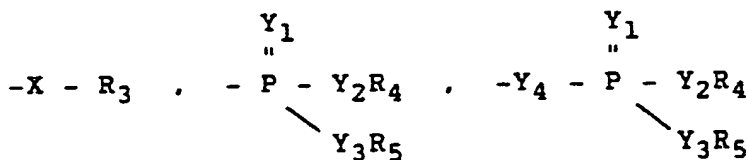
polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio,



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alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



$Y'_{63}$  and  $Y'_{64}$  are the same or different  
 and are one or more hydrogen, halogen,  
 alkylcarbonyl, alkylcarbonylalkyl,  
 alkoxycarbonylalkyl, alkoxycarbonylalkylthio,  
 polyhaloalkenylthio, thiocyano, propargylthio,  
 hydroxyimino, alkoxyimino, trialkylsilyloxy,  
 aryldialkylsilyloxy, triarylsilyloxy, formamidino,  
 alkylsulfamido, dialkylsulfamido, alkoxysulfonyl,

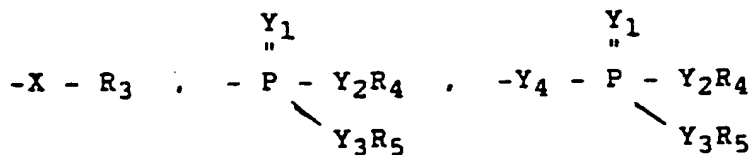
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polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio.

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haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxylalkylphosphinyl,  
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxylphosphino, hydroxyamino, alkoxylamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,  
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>.



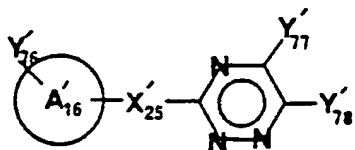
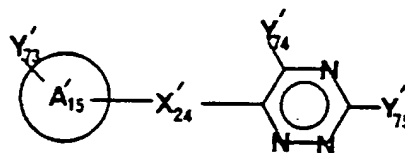
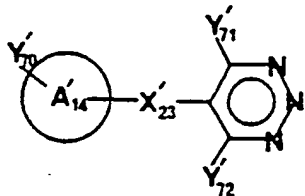
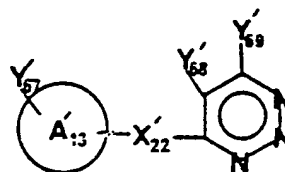
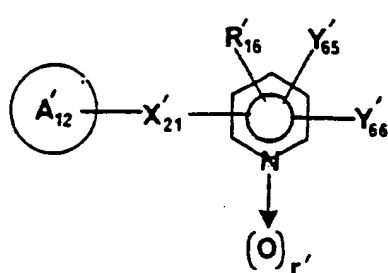
or



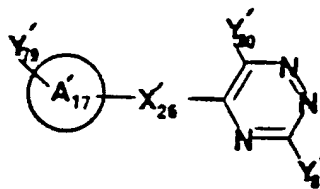
wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub> and Y<sub>4</sub> are as defined in claim 1.

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16. The method of claim 1 in which the compound has the formula selected from



and



wherein:

Y'65, Y'66, Y'67, Y'68, Y'69,  
Y'70, Y'71, Y'72, Y'73, Y'74, Y'75,  
Y'76, Y'77, Y'78, Y'79, Y'80 and Y'81  
are the same or different and Y'67, Y'70,  
Y'73, Y'76 and Y'79 are one or more hydrogen,  
halogen, alkylcarbonyl, alkylcarbonylalkyl,  
alkoxycarbonylalkyl, alkoxycarbonylalkylthio,

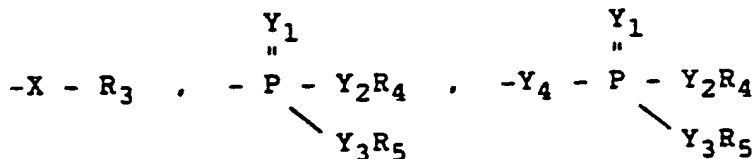
- 639 -

polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,

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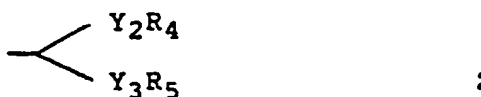
aryloxy, aralkoxy, arylthio, aralkylthio,  
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxylalkylphosphinyl,  
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxylphosphino, hydroxyamino, alkoxylamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,  
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>.



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or



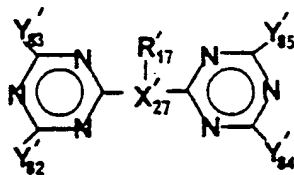
$r'$  is a value of 0 or 1;

$A'_{12}$ ,  $A'_{13}$ ,  $A'_{14}$ ,  $A'_{15}$ ,  $A'_{16}$  and  $A'_{17}$  are as defined for  $R_1$  in claim 1; and

$X'_{21}$ ,  $X'_{22}$ ,  $X'_{23}$ ,  $X'_{24}$ ,  $X'_{25}$  and  $X'_{26}$  are as defined for  $X$  in claim 1;

wherein  $X$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $Y_1$ ,  $Y_2$ ,  $Y_3$  and  $Y_4$  are as defined in claim 1.

17. The method of claim 1 in which the compound has the formula



wherein:

$Y'_{82}$ ,  $Y'_{83}$ ,  $Y'_{84}$ ,  $Y'_{85}$  and  $R'_{17}$  are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl.

- 642 -

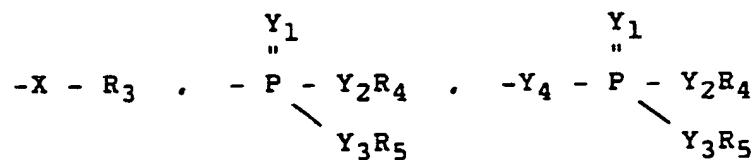
nitro, cyano, hydroxycarbonyl and derivative salts  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,



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dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



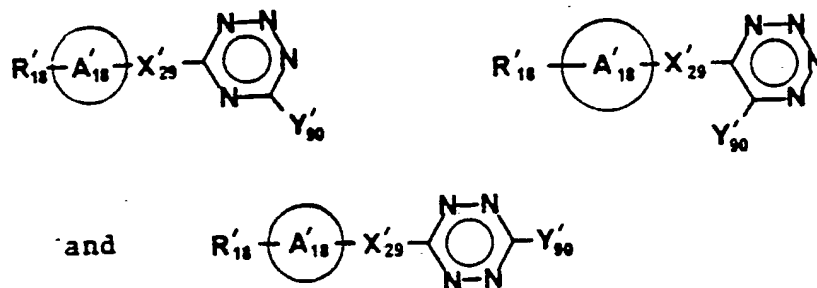
or



$X'_{27}$  is as defined for X in claim 1;  
 wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$  and  
 $Y_4$  are as defined in claim 1.

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18. The method of claim 1 in which the compound has the formula selected from



wherein:

$R'_{18}$  and  $Y'_{90}$  are the same or different and  $R'_{18}$  is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino,

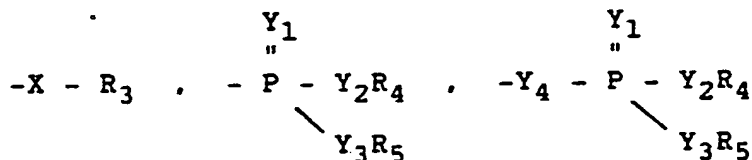
- 645 -

alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,

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trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



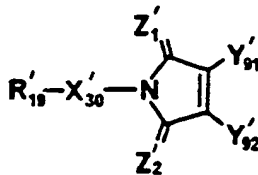
$A'_{18}$  is as defined for  $R_1$  in claim 1;

and

$X'_{29}$  is as defined for  $X$  in claim 1;

wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$  and  
 $Y_4$  are as defined in claim 1.

19. The method of claim 1 in which the  
 compound has the formula



- 647 -

wherein:

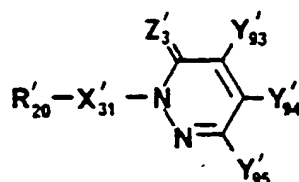
$R'_{19}$  is as defined for  $R_1$  in claim 1;

$X'_{30}$  is as defined for X in claim 1;

$Z'_1$  and  $Z'_2$  are independently O, S,  $C_1-C_8$  alkylidene, substituted or unsubstituted benzylidene, NH or  $NR'''$  wherein  $R'''$  is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

$Y'_{91}$  and  $Y'_{92}$  are independently halogen, alkyl or alkoxy.

20. The method of claim 1 in which the compound has the formula



wherein:

$R'_{20}$  is as defined for  $R_1$  in claim 1;

$X'_{31}$  is as defined for X in claim 1;

$Z'_3$  is O, S,  $C_1-C_8$  alkylidene, substituted or unsubstituted benzylidene, NH or  $NR'''$  wherein  $R'''$  is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

$Y'_{93}$ ,  $Y'_{94}$  and  $Y'_{95}$  are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl,

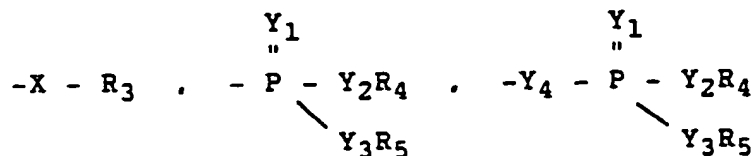
- 648 -

polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio,

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haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium.

$-X, = X, -X = R_3, = X-R_3,$



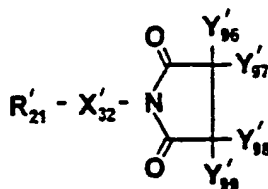
or



wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$  and  $Y_4$  are as defined in claim 1.

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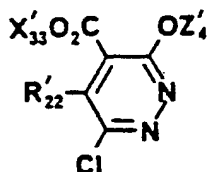
21. The method of claim 1 in which the compound has the formula



wherein:

R'21 is as defined for R1 in claim 1;  
 X'32 is as defined for X in claim 1; and  
 Y'96, Y'97, Y'98 and Y'99 are the same or different and are hydrogen, halogen, alkyl or alkoxy.

22. The method of claim 1 in which the compound has the formula



wherein:

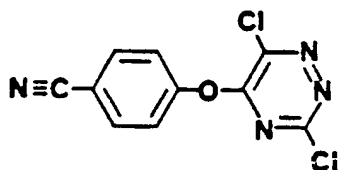
R'22 is as defined for R1 in claim 1;  
 and

X'33 and Z'4 are independently hydrogen, halogen, hydroxy, alkyl, alkoxy, alkylcarbonyl or alkoxy carbonyl.

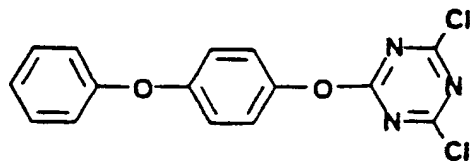


- 651 -

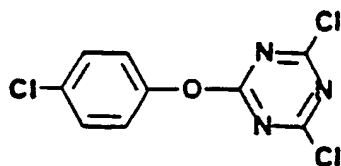
23. The method of claim 1 in which the compound has the formula



24. The method of claim 1 in which the compound has the formula

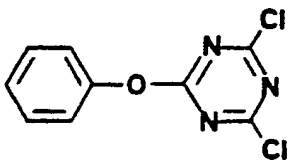


25. The method of claim 1 in which the compound has the formula

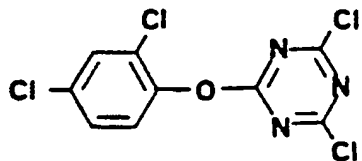


26. The method of claim 1 in which the compound has the formula

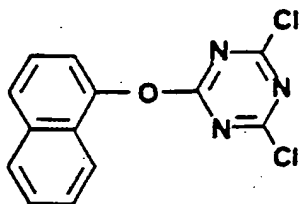
- 652 -



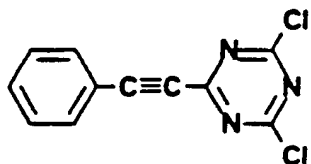
27. The method of claim 1 in which the compound has the formula



28. The method of claim 1 in which the compound has the formula

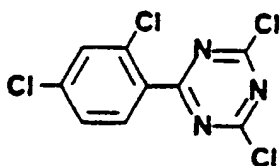


29. The method of claim 1 in which the compound has the formula

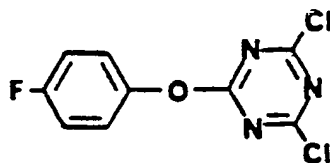


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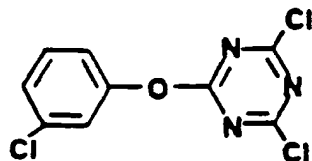
30. The method of claim 1 in which the compound has the formula



31. The method of claim 1 in which the compound has the formula

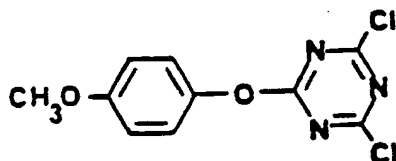


32. The method of claim 1 in which the compound has the formula

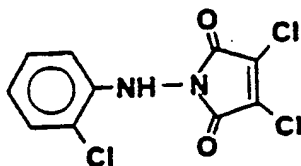


33. The method of claim 1 in which the compound has the formula

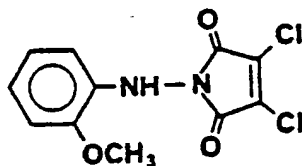
- 654 -



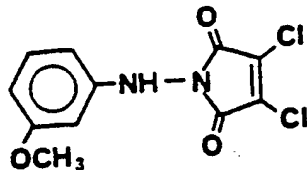
34. The method of claim 1 in which the compound has the formula



35. The method of claim 1 in which the compound has the formula

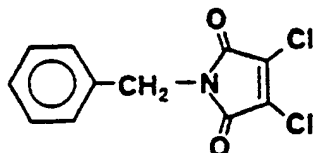


36. The method of claim 1 in which the compound has the formula

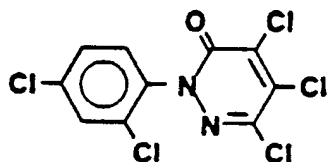


37. The method of claim 1 in which the compound has the formula

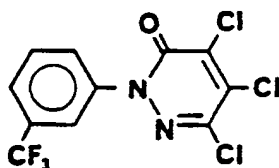
- 655 -



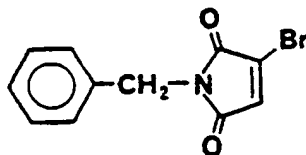
38. The method of claim 1 in which the compound has the formula



39. The method of claim 1 in which the compound has the formula



40. The method of claim 1 in which the compound has the formula



41. A method of reducing moisture loss from plants which comprises applying to the plant surface an effective amount, sufficient to reduce moisture loss from the plant surface without substantially inhibiting plant photosynthetic electron transport, of a compound of claim 105.

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42. The method of claim 1 wherein the compound is applied to the plant surface in an amount sufficient to reduce moisture loss from the plant surface without causing substantial inhibition of plant photosynthetic light reactions.

43. The method of claim 1 wherein the compound is applied to the plant surface at a condition of substantially no plant water stress.

44. The method of claim 1 wherein the compound is applied to the plant surface at a period prior to the plant reproductive growth phase.

45. The method of claim 1 wherein the compound is applied to the plant surface at a period prior to substantial soil moisture loss.

46. The method of claim 1 wherein the compound is applied to the plant surface at a period during the plant reproductive growth phase.

47. The method of claim 1 wherein the compound is applied to the plant surface at a concentration of from about 0.1 to about 100 pounds of compound per acre.

48. The method of claim 1 wherein the compound is applied to the plant surface at a concentration of from about 0.25 to about 15 pounds of compound per acre.

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49. The method of claim 1 wherein the plant is any agronomic or horticultural crop, ornamental or turfgrass.

50. The method of claim 1 wherein the plant is selected from corn, cotton, sweet potatoes, white potatoes, alfalfa, wheat, rye, upland rice, barley, oats, sorghum, dry beans, soy beans, sugar beets, sunflowers, tobacco, tomatoes, canola, deciduous fruit, citrus fruit, tea, coffee, olives, pineapple, cocoa, banana, sugar cane, oil palm, herbaceous bedding plants, woody shrubs, turfgrasses, ornamental plants, evergreens, trees, and flowers.

51. The method of claim 1 wherein the plant is transplanted stock.

52. The method of claim 51 wherein the transplanted stock is selected from tobacco, tomatoes, eggplant, cucumbers, lettuce, strawberries, herbaceous bedding plants, woody shrubs and tree seedlings.

53. A method of increasing crop yield which comprises applying to the crop an effective amount, sufficient to increase crop yield without substantially inhibiting plant photosynthetic electron transport, of a compound having the formula:



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wherein:

$R_1$  is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and



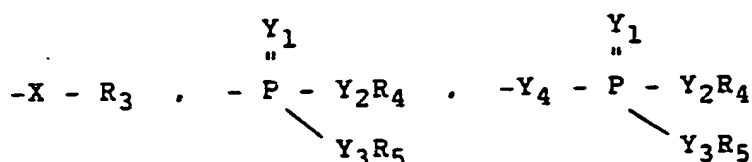
- 659 -

derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,

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dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



$R_1$  is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts

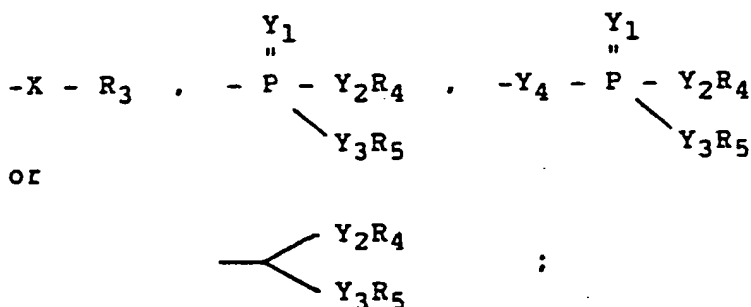
- 661 -

formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl,

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carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxylalkylphosphinyl,  
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxylphosphino, hydroxyamino, alkoxylamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,  
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



X is a covalent single bond or double bond,  
 a substituted or unsubstituted heteroatom or  
 substituted carbon atom, or a substituted or  
 unsubstituted, branched or straight chain containing  
 two or more carbon atoms or heteroatoms in any  
 combination in which the permissible substituents  
 are the same or different and are one or more  
 hydrogen, halogen, alkylcarbonyl,

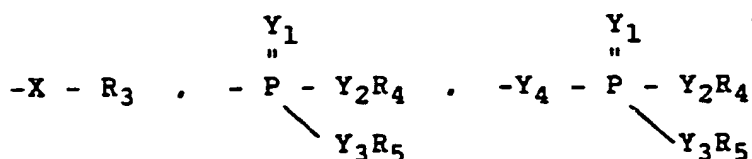
- 663 -

alkylcarbonylalkyl, alkoxycarbonylalkyl,  
alkoxycarbonylalkylthio, polyhaloalkenylthio,  
thiocyano, propargylthio, hydroxyimino, alkoxyimino,  
trialkylsilyloxy, aryldialkylsilyloxy,  
triarylsilyloxy, formamidino, alkylsulfamido,  
dialkylsulfamido, alkoxysulfonyl,  
polyhaloalkoxysulfonyl, hydroxy, amino,  
aminocarbonyl, alkylaminocarbonyl,  
dialkylaminocarbonyl, aminothiocarbonyl,  
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
nitro, cyano, hydroxycarbonyl and derivative salts  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group

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condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X. = X. -X = R_3. = X-R_3.$



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or



$R_2$  is a substituted or unsubstituted, heterocyclic ring system having at least one nitrogen atom which is selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,

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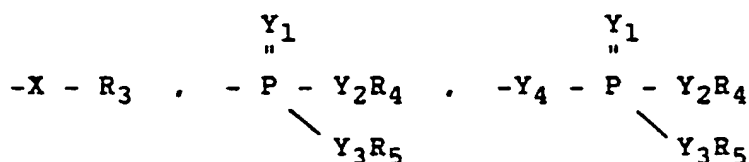
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxylalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,



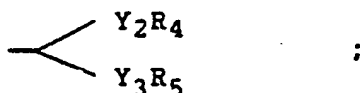
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isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium.

$-X, = X, -X = R_3, = X-R_3,$



or



wherein:

$R_3$  is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy,

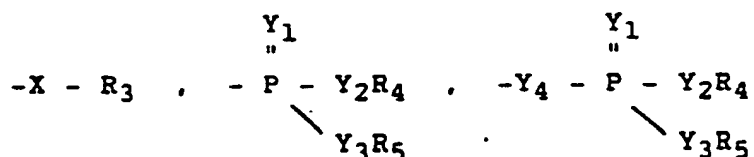
- 668 -

triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl,

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arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyposphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>.



or

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$R_3$  is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and

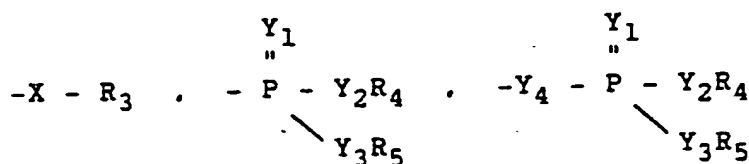
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derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,

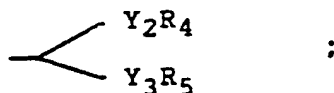
- 672 -

dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



$Y_1$  and  $Y_4$  are independently oxygen or sulfur;

$Y_2$  and  $Y_3$  are independently oxygen, sulfur, amino or a covalent bond; and

$R_4$  and  $R_5$  are independently hydrogen or substituted or unsubstituted alkyl, polyhaloalkyl, phenyl or benzyl in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl.

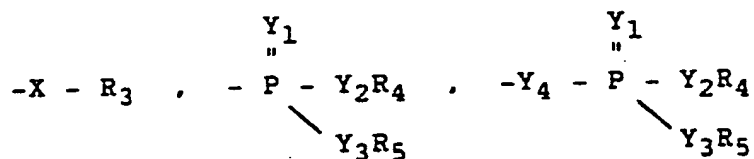
- 673 -

alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,

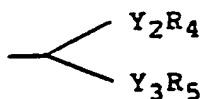
- 674 -

aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxylalkylphosphinyl,  
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxylphosphino, hydroxyamino, alkoxylamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,  
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>,



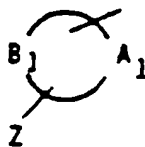
or



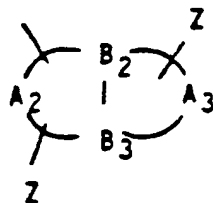
54. The method of claim 53 wherein R<sub>1</sub>  
 and R<sub>3</sub> are independently a substituted or  
 unsubstituted, carbocyclic or heterocyclic ring  
 system selected from a monocyclic aromatic or  
 nonaromatic ring system having the formula



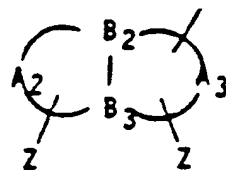
- 675 -



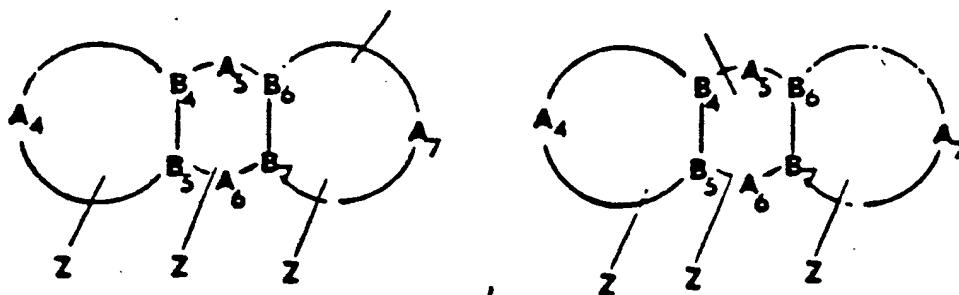
a bicyclic aromatic or nonaromatic ring system  
having the formula selected from



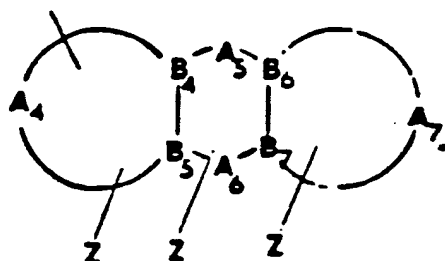
and



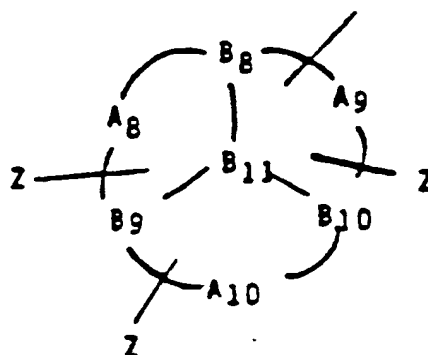
a polycyclic aromatic or nonaromatic ring system  
having the formula selected from



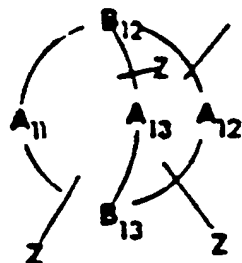
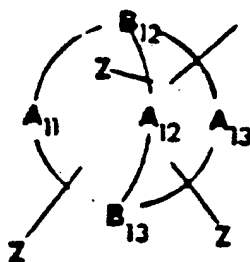
- 676 -



and

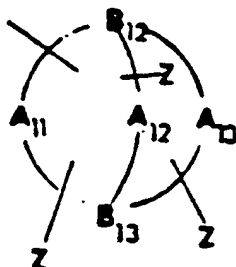


and a bridged ring system which may be saturated or unsaturated having the formula selected from



- 677 -

and



wherein:

$A_1$  represents a ring-forming chain of atoms which together with  $B_1$  forms a carbocyclic or heterocyclic ring system containing from 0 to 4 double bonds or from 0 to 2 triple bonds;

$B_1$  represents a saturated or unsaturated carbon atom;

$A_2$  and  $A_3$  independently represent a ring-forming chain of atoms which together with  $B_2$  and  $B_3$  form a carbocyclic or heterocyclic ring system;

$B_2$  and  $B_3$  are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

$A_4$ ,  $A_5$ ,  $A_6$  and  $A_7$  independently represent a ring-forming chain of atoms which together with  $B_4$ ,  $B_5$ ,  $B_6$  and  $B_7$  form a carbocyclic or heterocyclic ring system;

$B_4$ ,  $B_5$ ,  $B_6$  and  $B_7$  are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

$A_8$ ,  $A_9$  and  $A_{10}$  independently represent a ring-forming chain of atoms which

- 678 -

together with B<sub>8</sub>, B<sub>9</sub>, B<sub>10</sub> and B<sub>11</sub> form a carbocyclic or heterocyclic ring system;

B<sub>8</sub>, B<sub>9</sub> and B<sub>10</sub> are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

B<sub>11</sub> represents a saturated or unsaturated carbon atom, nitrogen atom or phosphorous atom;

A<sub>11</sub>, A<sub>12</sub> and A<sub>13</sub> independently represent a ring-forming chain of atoms which together with B<sub>12</sub> and B<sub>13</sub> form a carbocyclic or heterocyclic ring system;

B<sub>12</sub> and B<sub>13</sub> are independently a saturated carbon atom or a nitrogen atom; and

Z is the same or different and is one or more of hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio,

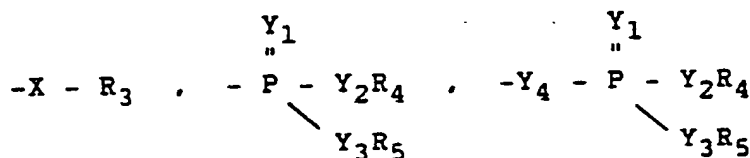
- 679 -

alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy,

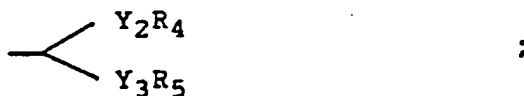
- 680 -

arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

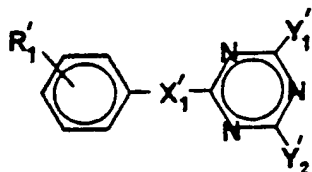


or



wherein  $R_3, R_4, R_5, Y_1, Y_2, Y_3, Y_4$  and  $X$  are as defined in claim 42.

55. The method of claim 53 in which the compound has the formula



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wherein:

R'<sub>1</sub> is the same or different and is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,

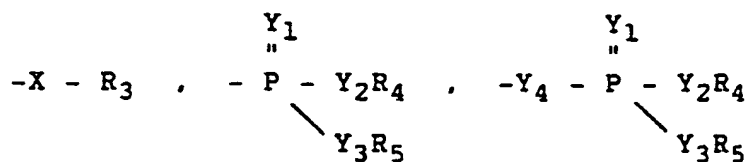
- 682 -

alkoxyiminomethyl, unsubstituted or substituted  
 aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
 or substituted arylhydrazonomethyl, a hydroxy group  
 condensed with a mono-, di- or polysaccharide,  
 haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
 aryloxy, aralkoxy, arylthio, aralkylthio,  
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

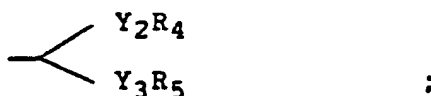
$-X, = X, -X = R_3, = X-R_3,$



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or

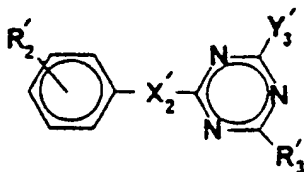


$X'_1$  is O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a single covalent bond, CH<sub>2</sub>O, CH<sub>2</sub>S, -CH(CH<sub>3</sub>)O, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-; and

$Y'_1$  and  $Y'_2$  are independently halogen, alkyl or alkoxy;

wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub> and Y<sub>4</sub> are as defined in claim 42.

56. The method of claim 53 in which the compound has the formula



wherein:

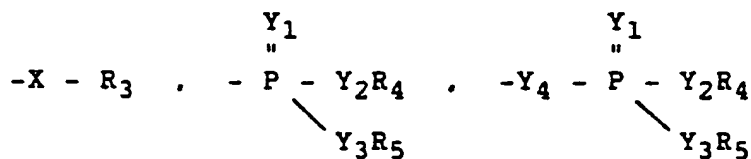
R'<sub>2</sub> and R'<sub>3</sub> are the same or different and R'<sub>2</sub> is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryl dialkylsilyloxy, triaryl silyloxy, formamidino,

- 684 -

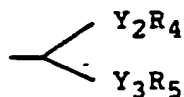
alkylsulfamido, dialkylsulfamido, trialkylsilyloxy, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,

- 685 -

haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,  
-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>.



or



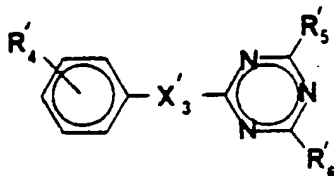
- 686 -

$X'_2$  is O, S, SO,  $SO_2$ , NH,  $CH_2$ , CO, a single covalent bond,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$  or  $-CH_2SO_2-$ ; and

$Y'_3$  is halogen;

wherein X,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $Y_1$ ,  $Y_2$ ,  $Y_3$  and  $Y_4$  are as defined in claim 42.

57. The method of claim 53 in which the compound has the formula



wherein:

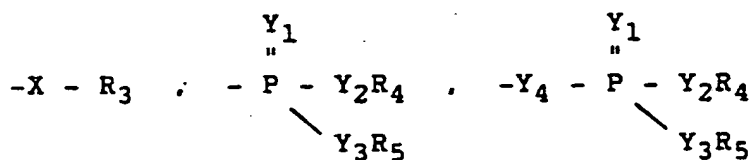
$R'_4$ ,  $R'_5$  and  $R'_6$  are the same or different and  $R'_4$  is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryl dialkylsilyloxy, triaryl silyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl.

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alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,

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aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxylalkylphosphinyl,  
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxylphosphino, hydroxyamino, alkoxylamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,  
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium.  
 $-X, = X, -X = R_3, = X-R_3,$



or

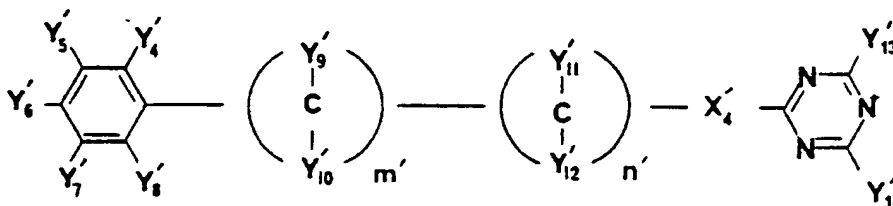


$X'_3$  is O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a  
 single covalent bond, -CH(CH<sub>3</sub>)O-, -CH(CN)O-,  
 -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-,  
 -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)-  
 or -CONH-:

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wherein  $X$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $Y_1$ ,  $Y_2$ ,  $Y_3$  and  $Y_4$  are as defined in claim 42.

58. The method of claim 53 in which the compound has the formula



wherein:

$Y'_4$ ,  $Y'_5$ ,  $Y'_6$ ,  $Y'_7$  and  $Y'_8$  are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl,

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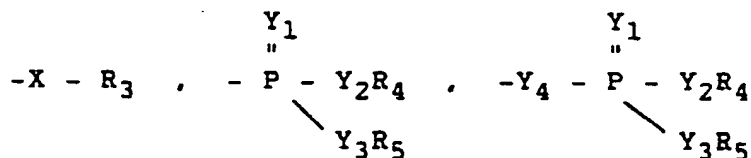
polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio,



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alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



$Y'_9, Y'_{10}, Y'_{11}$  and  $Y'_{12}$  are the same or different and are hydrogen, halogen, alkyl, polyhaloalkyl, cyano or aryl;

$m'$  and  $n'$  are the same or different and are a value of from 0 to 5;

$X'_4$  is O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a single covalent bond,  $-\text{CH}(\text{CH}_3)\text{O}-$ ,  $-\text{CH}(\text{CN})\text{O}-$ ,  $-\text{CH}=\text{NO}-$ ,  $-\text{C}(\text{CH}_3)=\text{NO}-$ ,  $-\text{CH}_2\text{CH}_2\text{O}-$ ,  $-\text{C}\equiv\text{C}-$ ,

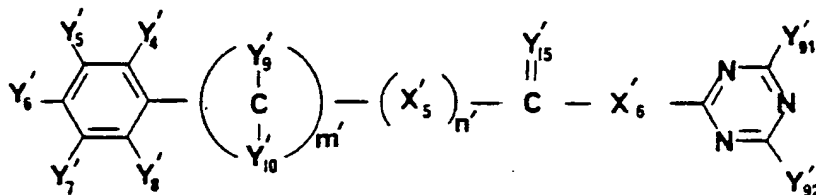
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$-\text{CH}_2\text{SO}-$ ,  $-\text{CH}_2\text{SO}_2-$ ,  $-\text{OCH}_2\text{CH}_2\text{O}-$ ,  $-\text{CH}(\text{alkyl})-$   
or  $-\text{CONH}-$ ; and

$\text{Y}'_{13}$  and  $\text{Y}'_{14}$  are the same or different  
and are halogen, alkyl or alkoxy;

wherein  $\text{X}$ ,  $\text{R}_3$ ,  $\text{R}_4$ ,  $\text{R}_5$ ,  $\text{Y}_1$ ,  $\text{Y}_2$ ,  $\text{Y}_3$  and  
 $\text{Y}_4$  are as defined in claim 42.

59. The method of claim 53 in which the  
compound has the formula



wherein:

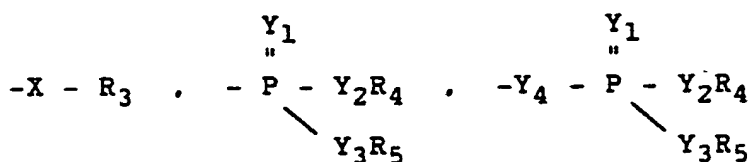
$\text{Y}'_4$ ,  $\text{Y}'_5$ ,  $\text{Y}'_6$ ,  $\text{Y}'_7$  and  $\text{Y}'_8$  are  
the same or different and are hydrogen, halogen,  
alkylcarbonyl, alkylcarbonylalkyl,  
alkoxycarbonylalkyl, alkoxycarbonylalkylthio,  
polyhaloalkenylthio, thiocyno, propargylthio,  
hydroxyimino, alkoxyimino, trialkylsilyloxy,  
aryldialkylsilyloxy, triarylsilyloxy, formamidino,  
alkylsulfamido, dialkylsulfamido, alkoxysulfonyl,  
polyhaloalkoxysulfonyl, hydroxy, amino,  
aminocarbonyl, alkylaminocarbonyl,  
dialkylaminocarbonyl, aminothiocarbonyl,  
alkylaminothiocarbonyl, dialkylaminothiocarbonyl.

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nitro, cyano, hydroxycarbonyl and derivative salts  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,

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dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,  
 $-X, = X, -X = R_3, = X-R_3,$



or



$Y'_9$  and  $Y'_{10}$  are the same or different  
 and are hydrogen, halogen, alkyl, polyhaloalkyl,  
 cyano or aryl;

$m'$  and  $n'$  are the same or different and are  
 a value of from 0 to 5;

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$X'_5$  is the same or different and is O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a single covalent bond, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-;

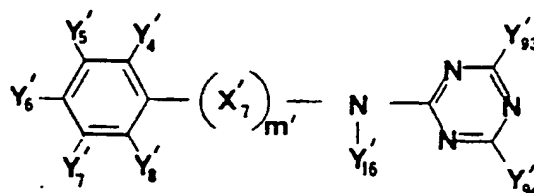
$Y'_{15}$  is O or S;

$Y'_{91}$  and  $Y'_{92}$  are independently halogen; and

$X'_6$  is O or S;

wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub> and Y<sub>4</sub> are as defined in claim 42.

60. The method of claim 53 in which the compound has the formula



wherein:

$Y'_4$ ,  $Y'_5$ ,  $Y'_6$ ,  $Y'_7$  and  $Y'_8$  are the same as different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino,

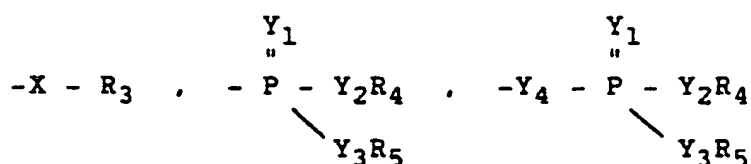
- 696 -

alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,

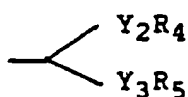
- 697 -

haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



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$X'_7$  is the same or different and is O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a single covalent bond, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-;

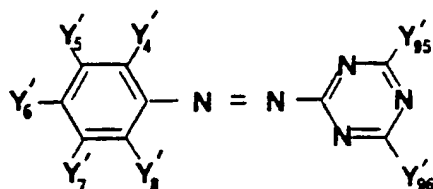
$m'$  is a value of from 0 to 5;

$Y'_{93}$  and  $Y'_{94}$  are independently halogen;

$Y'_{16}$  is hydrogen, alkyl, alkylcarbonyl, alkylsulfonyl, or polyhaloalkylsulfonyl;

wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub> and Y<sub>4</sub> are as defined in claim 42.

61. The method of claim 53 in which the compound has the formula



wherein:

$Y'_{4}$ ,  $Y'_{5}$ ,  $Y'_{6}$ ,  $Y'_{7}$  and  $Y'_{8}$  are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl,

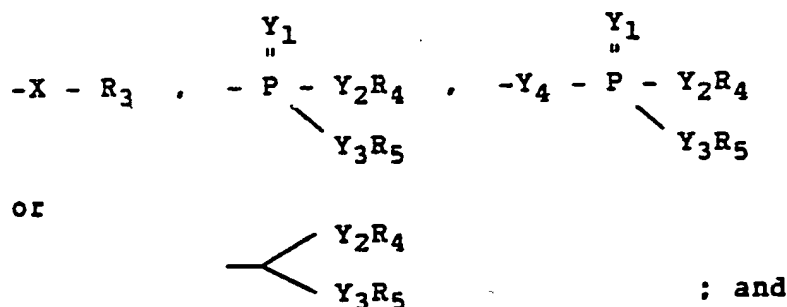


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polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio,

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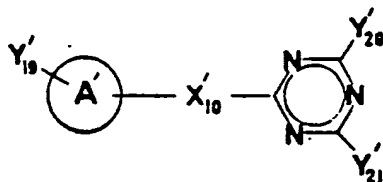
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxylalkylphosphinyl,  
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxylphosphino, hydroxyamino, alkoxylamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,  
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,  
 $-X, = X, -X = R_3, = X-R_3,$



$Y_{95}$  and  $Y_{96}$  are independently halogen;  
 wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$  and  
 $Y_4$  are as defined in claim 42.

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62. The method of claim 53 in which the compound has the formula



wherein:

$Y'_{19}$  and  $Y'_{21}$  are the same or different and  $Y'_{19}$  is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryl dialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl, nitro, cyano, hydroxy carbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxy alkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl,

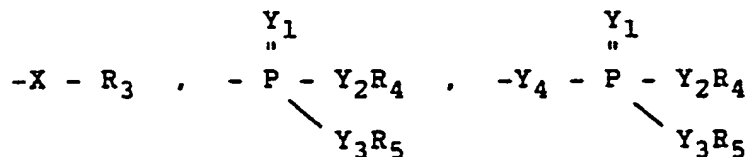
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aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl,

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alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



A' is as defined for  $R_1$  in claim 42;

$X'_{10}$  is as defined for X in claim 42; and

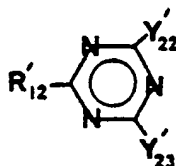
$Y'_{20}$  is halogen, cyano, alkyl, alkoxy,

polyhaloalkyl, polyhaloalkoxy, or

polyhaloalkylsulfonyloxy;

wherein X,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $Y_1$ ,  $Y_2$ ,  $Y_3$  and  $Y_4$  are as defined in claim 42.

63. The method of claim 53 in which the compound has the formula



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wherein:

R'<sub>12</sub> is as defined for R<sub>1</sub> in claim 42;

Y'<sub>22</sub> is halogen, cyano, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, or polyhaloalkylsulfonyloxy; and

Y'<sub>23</sub> is hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy,

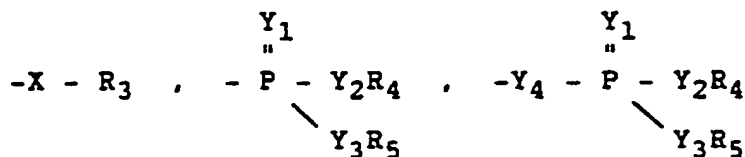
- 705 -

dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl, dialkoxyphosphino, hydroxyamino, alkoxyamino, aryloxyamino, aryloxyimino, oxo, thiono,

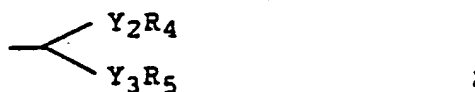
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alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3.$

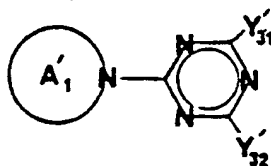


or



wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$  and  
 $Y_4$  are as defined in claim 42.

64. The method of claim 53 in which the  
compound has the formula



wherein:

$A'_1$  is as defined for  $R_2$  in claim 42;

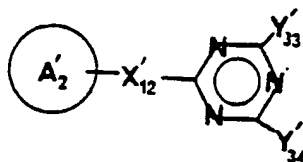
and

$Y'_{31}$  and  $Y'_{32}$  are the same or different  
and are halogen, alkyl or alkoxy.



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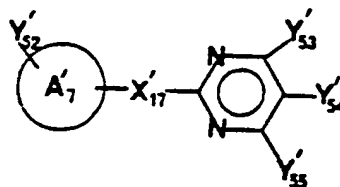
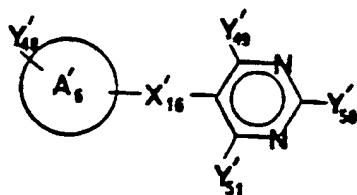
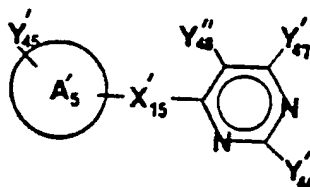
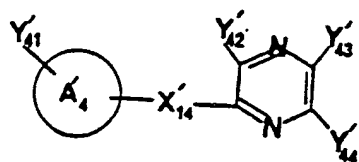
65. The method of claim 53 in which the compound has the formula



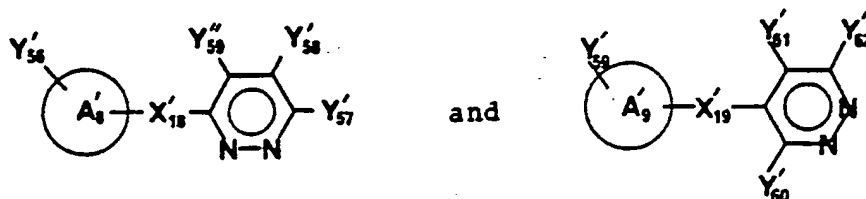
wherein:

$A'_2$  is as defined for  $R_1$  in claim 42;  
 $X'_{12}$  is as defined for  $X$  in claim 42; and  
 $Y'_{33}$  and  $Y'_{34}$  are the same or different  
 and are halogen, alkyl or alkoxy.

66. The method of claim 53 in which the compound has the formula selected from



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wherein:

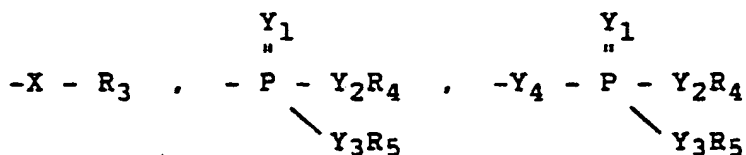
Y'<sub>41</sub>, Y'<sub>42</sub>, Y'<sub>43</sub>, Y'<sub>44</sub>, Y'<sub>45</sub>,  
 Y'<sub>46</sub>, Y'<sub>47</sub>, Y'<sub>48</sub>, Y'<sub>49</sub>, Y'<sub>50</sub>, Y'<sub>51</sub>,  
 Y'<sub>52</sub>, Y'<sub>53</sub>, Y'<sub>54</sub>, Y'<sub>55</sub>, Y'<sub>56</sub>,  
 Y'<sub>57</sub>, Y'<sub>58</sub>, Y'<sub>59</sub>, Y'<sub>60</sub>, Y'<sub>61</sub>, and  
 Y'<sub>62</sub> are the same or different and Y'<sub>41</sub>, Y'<sub>45</sub>,  
 Y'<sub>48</sub>, Y'<sub>52</sub>, Y'<sub>56</sub>, and Y'<sub>59</sub> are one or more  
 hydrogen, halogen, alkylcarbonyl,  
 alkylcarbonylalkyl, alkoxycarbonylalkyl,  
 alkoxycarbonylalkylthio, polyhaloalkenylthio,  
 thiocyano, propargylthio, hydroxyimino, alkoxyimino,  
 trialkylsilyloxy, aryldialkylsilyloxy,  
 triarylsilyloxy, formamidino, alkylsulfamido,  
 dialkylsulfamido, alkoxysulfonyl,  
 polyhaloalkoxysulfonyl, hydroxy, amino,  
 aminocarbonyl, alkylaminocarbonyl,  
 dialkylaminocarbonyl, aminothiocarbonyl,  
 alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
 nitro, cyano, hydroxycarbonyl and derivative salts,  
 formamido, alkyl, alkoxy, polyhaloalkyl,  
 polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
 which the permissible substituents are the same or  
 different and are one or two propargyl, alkoxyalkyl,  
 alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
 polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
 alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
 polyhaloalkylsulfonyl, alkylsulfonylamino,  
 alkylcarbonylamino, polyhaloalkylsulfonylamino,  
 polyhaloalkylcarbonylamino, trialkylsilyl.

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aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl,

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alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$$-X_1 = X_1, \quad -X_2 = R_3, \quad = X - R_3.$$


OR

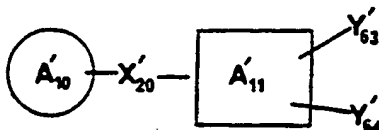


A'<sub>4</sub>, A'<sub>5</sub>, A'<sub>6</sub>, A'<sub>7</sub>, A'<sub>8</sub> and A'<sub>9</sub>  
are as defined for R<sub>1</sub> in claim 42; and

X' <sub>14</sub>, X' <sub>15</sub>, X' <sub>16</sub>, X' <sub>17</sub>, X' <sub>18</sub> and X' <sub>19</sub> are the same or different and are O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, CO, a single covalent bond, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-;

wherein X, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, Y<sub>1</sub>, Y<sub>2</sub>, Y<sub>3</sub>, and Y<sub>4</sub> are as defined in claim 42.

67. The method of claim 53 in which the compound has the formula



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wherein:

A'<sub>10</sub> is as defined for R<sub>1</sub> in claim 42;

X'<sub>20</sub> is as defined for X in claim 42;

A'<sub>11</sub> is a substituted or unsubstituted, 5-membered heterocyclic ring system having at least one nitrogen atom in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy,

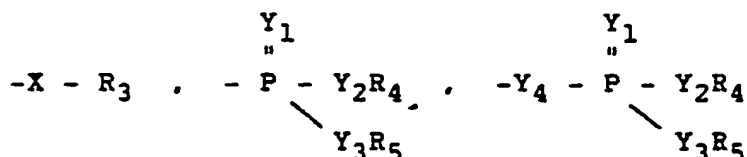
- 712 -

dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,

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alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



$Y'_{63}$  and  $Y'_{64}$  are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,

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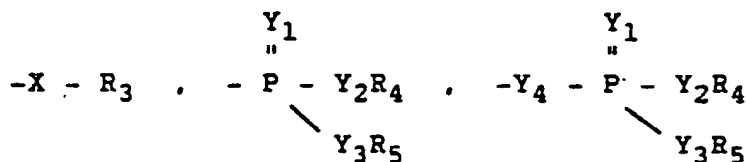
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxylalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxylalkoxy, carboxylalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,



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isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

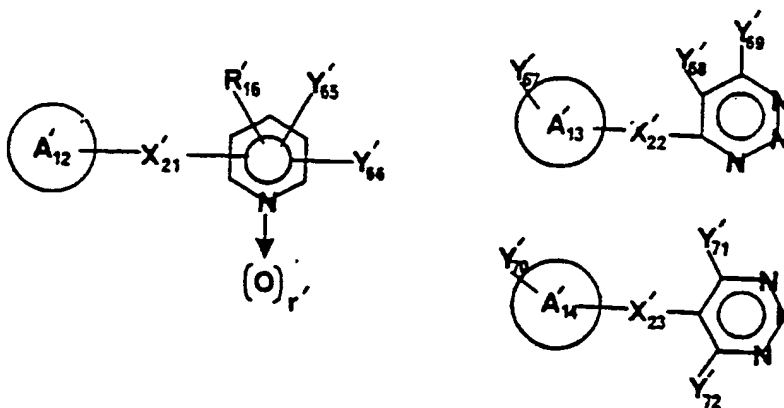


or

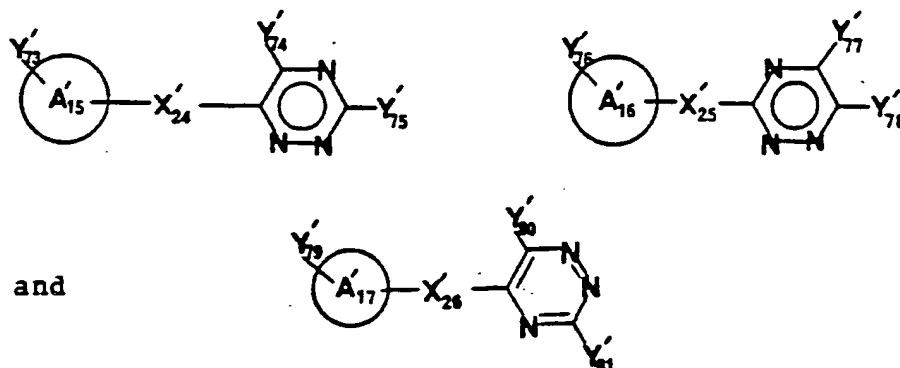


wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$  and  $Y_4$  are as defined in claim 42.

68. The method of claim 53 in which the compound has the formula selected from



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wherein:

Y'<sup>65</sup>, Y'<sup>66</sup>, Y'<sup>67</sup>, Y'<sup>68</sup>, Y'<sup>69</sup>,  
 Y'<sup>70</sup>, Y'<sup>71</sup>, Y'<sup>72</sup>, Y'<sup>73</sup>, Y'<sup>74</sup>, Y'<sup>75</sup>,  
 Y'<sup>76</sup>, Y'<sup>77</sup>, Y'<sup>78</sup>, Y'<sup>79</sup>, Y'<sup>80</sup> and Y'<sup>81</sup>  
 are the same or different and Y'<sup>67</sup>, Y'<sup>70</sup>,  
 Y'<sup>73</sup>, Y'<sup>76</sup> and Y'<sup>79</sup> are one or more hydrogen,  
 halogen, alkylcarbonyl, alkylcarbonylalkyl,  
 alkoxycarbonylalkyl, alkoxycarbonylalkylthio,  
 polyhaloalkenylthio, thiocyno, propargylthio,  
 hydroxyimino, alkoxyimino, trialkylsilyloxy,  
 arylalkylsilyloxy, triarylsilyloxy, formamidino,  
 alkylsulfamido, dialkylsulfamido, alkoxysulfonyl,  
 polyhaloalkoxysulfonyl, hydroxy, amino,  
 aminocarbonyl, alkylaminocarbonyl,  
 dialkylaminocarbonyl, aminothiocarbonyl,  
 alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
 nitro, cyano, hydroxycarbonyl and derivative salts,  
 formamido, alkyl, alkoxy, polyhaloalkyl,  
 polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
 which the permissible substituents are the same or  
 different and are one or two propargyl, alkoxyalkyl,  
 alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
 polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
 alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
 polyhaloalkylsulfonyl, alkylsulfonylamino.

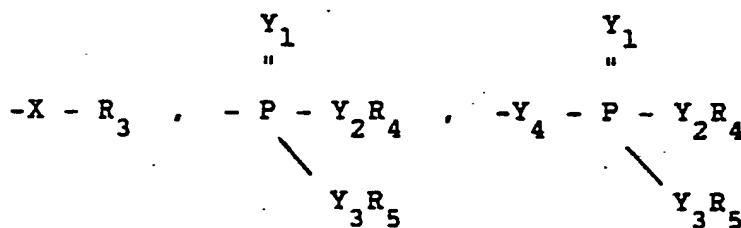
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alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino,

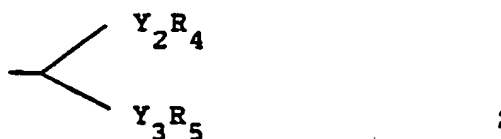
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trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



$r'$  is a value of 0 or 1;

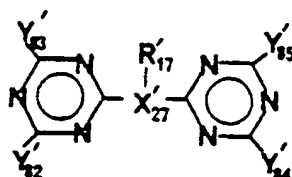
$A'_{12}, A'_{13}, A'_{14}, A'_{15}, A'_{16}$  and  
 $A'_{17}$  are as defined for  $R_1$  in claim 42; and

$X'_{21}, X'_{22}, X'_{23}, X'_{24}, X'_{25}$  and  
 $X'_{26}$  are as defined for  $X$  in claim 42;

wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$  and  
 $Y_4$  are as defined in claim 42.

69. The method of claim 53 in which the  
 compound has the formula

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wherein:

Y'82, Y'83, Y'84, Y'85 and R'17 are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and

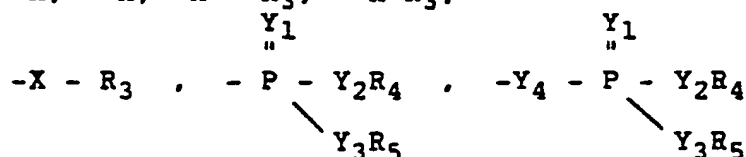
- 720 -

derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl.

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dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

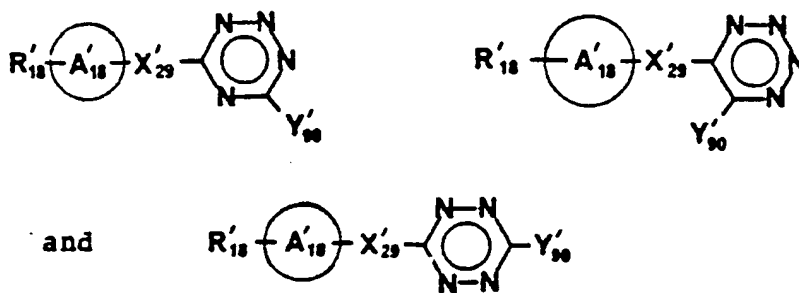


or



$X'_{27}$  is as defined for X in claim 42;  
 wherein X,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $Y_1$ ,  $Y_2$ ,  $Y_3$  and  
 $Y_4$  are as defined in claim 42.

70. The method of claim 53 in which the  
 compound has the formula selected from



wherein:

$R'_{18}$  and  $Y'_{90}$  are the same or different  
 and  $R'_{18}$  is one or more hydrogen, halogen,  
 alkylcarbonyl, alkylcarbonylalkyl,  
 alkoxy carbonylalkyl, alkoxy carbonylalkylthio,

- 722 -

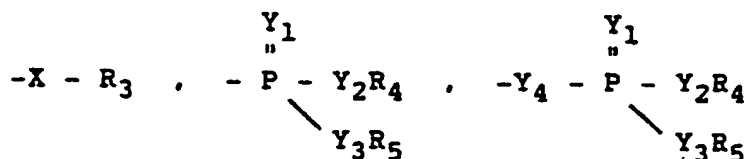
polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,



- 723 -

aryloxy, aralkoxy, arylthio, aralkylthio,  
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxylalkylphosphinyl,  
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxylphosphino, hydroxyamino, alkoxylamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,  
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

-X. = X. -X = R<sub>3</sub>. = X-R<sub>3</sub>.



or

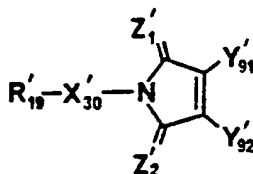
- 724 -



$A'_{18}$  is as defined for  $R_1$  in claim 42;  
and

$X'_{29}$  is as defined for  $X$  in claim 42;  
wherein  $X$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $Y_1$ ,  $Y_2$ ,  $Y_3$  and  
 $Y_4$  are as defined in claim 42.

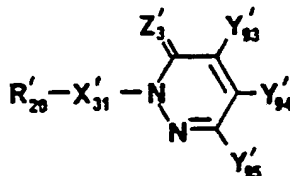
71. The method of claim 53 in which the  
compound has the formula



wherein:

$R'_{19}$  is as defined for  $R_1$  in claim 1;  
 $X'_{30}$  is as defined for  $X$  in claim 1;  
 $Z'_1$  and  $Z'_2$  are independently O, S,  
 $C_1-C_8$  alkylidene, substituted or unsubstituted  
benzylidene, NH or  $NR'''$  wherein  $R'''$  is alkyl,  
aryl, aralkyl, alkenyl or alkynyl; and  
 $Y'_{91}$  and  $Y'_{92}$  are independently  
halogen, alkyl or alkoxy.

72. The method of claim 53 in which the  
compound has the formula



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wherein:

$R'_{20}$  is as defined for  $R_1$  in claim 1;

$X'_{31}$  is as defined for  $X$  in claim 1;

$Z'_3$  is O, S,  $C_1-C_8$  alkylidene,

substituted or unsubstituted benzylidene, NH or NR'' wherein  $R''$  is alyl, aryl, aralkyl, alkenyl or alkynyl; and

$Y'_{93}$ ,  $Y'_{94}$  and  $Y'_{95}$  are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative

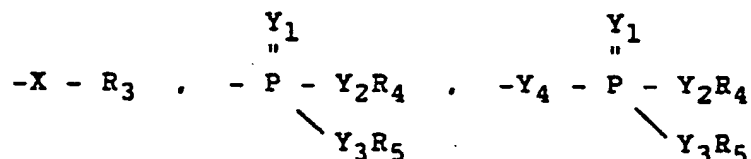
- 726 -

salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,

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dialkoxyposphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

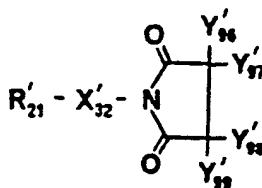


or



wherein  $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$  and  $Y_4$  are as defined in claim 1.

73. The method of claim 53 in which the compound has the formula



wherein:

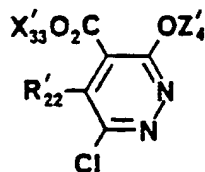
$R'_{21}$  is as defined for  $R_1$  in claim 1;

$X'_{32}$  is as defined for  $X$  in claim 1; and

$Y'_{96}, Y'_{97}, Y'_{98}$  and  $Y'_{99}$  are the same or different and are hydrogen, halogen, alkyl or alkoxy.

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74. The method of claim 53 in which the compound has the formula



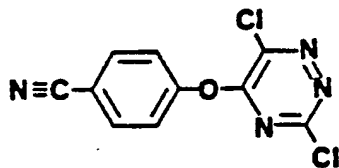
wherein:

$R'_{22}$  is as defined for  $R_1$  in claim 1;

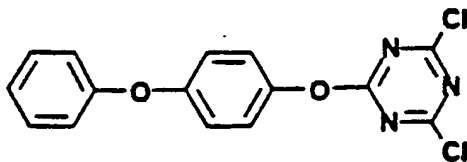
and

$X'_{33}$  and  $Z'_4$  are independently hydrogen, halogen, hydroxy, alkyl, alkoxy, alkylcarbonyl or alkoxy carbonyl.

75. The method of claim 53 in which the compound has the formula

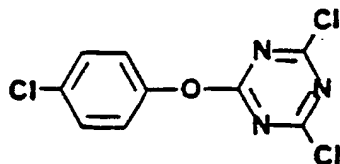


76. The method of claim 53 in which the compound has the formula

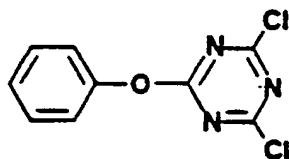


- 729 -

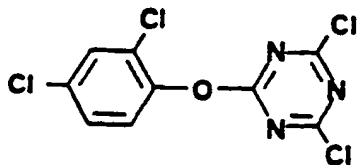
77. The method of claim 53 in which the compound has the formula



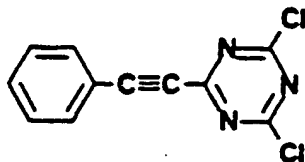
78. The method of claim 53 in which the compound has the formula



79. The method of claim 53 in which the compound has the formula

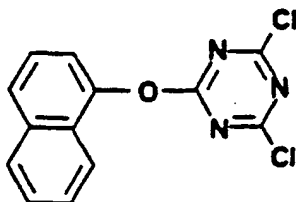


80. The method of claim 53 in which the compound has the formula

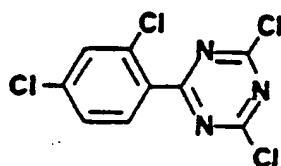


- 730 -

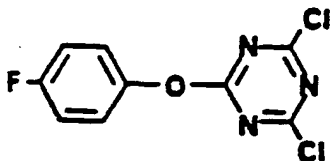
81. The method of claim 53 in which the compound has the formula



82. The method of claim 53 in which the compound has the formula



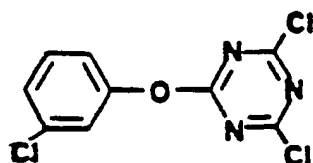
83. The method of claim 53 in which the compound has the formula



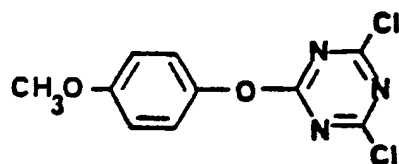
84. The method of claim 53 in which the compound has the formula



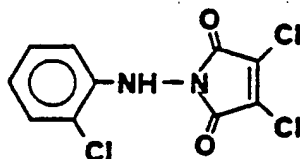
- 731 -



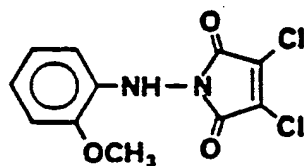
85. The method of claim 53 in which the compound has the formula



86. The method of claim 53 in which the compound has the formula

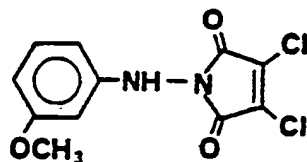


87. The method of claim 53 in which the compound has the formula

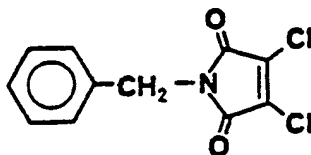


88. The method of claim 53 in which the compound has the formula

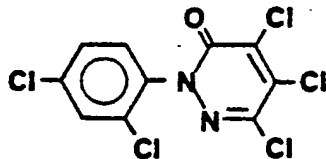
- 732 -



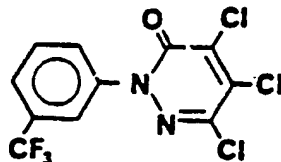
89. The method of claim 53 in which the compound has the formula



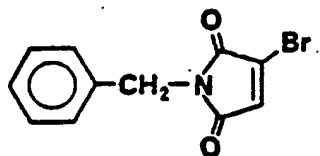
90. The method of claim 53 in which the compound has the formula



91. The method of claim 53 in which the compound has the formula



92. The method of claim 53 in which the compound has the formula



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93. A method of increasing crop yield which comprises applying to the crop an effective amount, sufficient to increase crop yield without substantially inhibiting plant photosynthetic electron transport, of a compound of claim 105.

94. The method of claim 53 wherein the compound is applied to the crop in an amount sufficient to increase crop yield without causing substantial inhibition of plant photosynthetic light reactions.

95. The method of claim 53 wherein the compound is applied to the crop at a condition of substantially no plant water stress.

96. The method of claim 53 wherein the compound is applied to the crop at a period prior to the plant reproductive growth phase.

97. The method of claim 53 wherein the compound is applied to the crop at a period prior to substantial soil moisture loss.

98. The method of claim 53 wherein the compound is applied to the crop at a period during the plant reproductive growth phase.

99. The method of claim 53 wherein the compound is applied to the crop at a concentration of from about 0.1 to about 100 pounds of compound per acre.

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100. The method of claim 53 wherein the compound is applied to the crop at a concentration of from about 0.25 to about 15 pounds of compound per acre.

101. The method of claim 53 wherein the crop is any agronomic or horticultural crop.

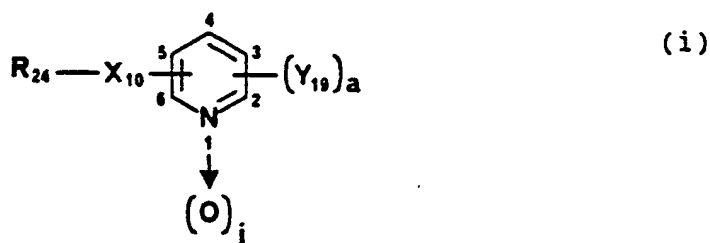
102. The method of claim 53 wherein the crop is selected from corn, cotton, sweet potatoes, white potatoes, alfalfa, wheat, rye, upland rice, barley, oats, sorghum, dry beans, soybeans, sugar beets, sunflowers, tobacco, tomatoes, canola, deciduous fruit, citrus fruit, tea, coffee, olives, pineapple, cocoa, banana, sugar cane and oil palm.

103. The method of claim 53 wherein the crop is transplanted stock.

104. The method of claim 103 wherein the transplanted stock is selected from tobacco, tomatoes, eggplant, cucumbers, lettuce, strawberries, herbaceous bedding plants, woody shrubs and tree seedlings.

105. A compound having the formula selected from the following:

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wherein:

$R_{24}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{10}$  represents O, S, SO,  $SO_2$ , NH,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$  or  $-CONH-$ ;

$j$  is a value of 0 or 1;

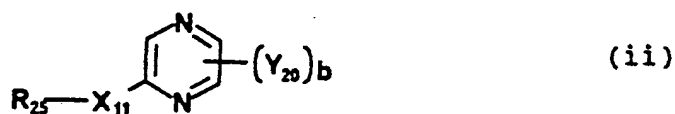
$a$  is a value of from 2 to 4 inclusive; and

$Y_{19}$  is the same or different and represents halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that (i) at least two ring position pairs selected from 2 and 4, 2 and 6, 2 and 3, and 3 and 4 are substituted with the same or different halogen;

(ii) when ring positions 2, 4 and 6 are substituted with chlorine and  $j$  is a value of 0 and  $X_{10}$  is  $SO_2$ , then  $R_{24}$  is not unsubstituted phenyl; and

(iii) when ring positions 2, 3 and 5 are substituted with chlorine and  $j$  is a value of 1 and  $X_{10}$  is S, then  $R_{24}$  is not unsubstituted phenyl;

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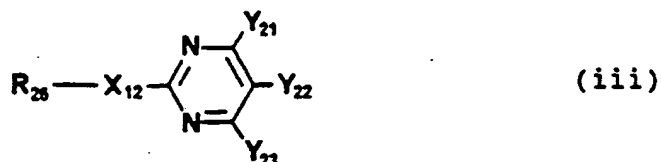
wherein:

$R_{25}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{11}$  represents O, S, SO,  $SO_2$ , NH,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$  or  $-CONH-$ ;

$b$  is a value of 2 to 3; and

$Y_{20}$  is the same or different and represents halogen, alkyl, cyano, polyhaloalkyl, polyhaloalkoxy, alkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that at least two of  $Y_{20}$  are halogen;



wherein:

$R_{26}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

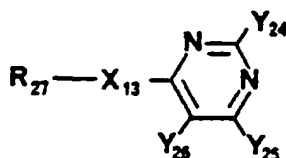
$X_{12}$  represents O, S, SO,  $SO_2$ , NH,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,

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-CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-,  
 -CH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -C≡C-, -CH<sub>2</sub>SO-,  
 -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-;

Y<sub>21</sub> and Y<sub>22</sub> are independently the same or different halogen; and

Y<sub>23</sub> represents hydrogen, halogen, alkyl, polyhaloalkyl, alkoxy, polyhaloalkoxy, cyano, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl;



(iv)

wherein:

R<sub>27</sub> represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

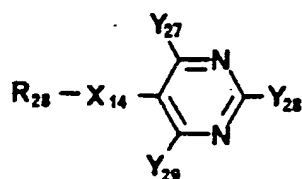
X<sub>13</sub> represents O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, a single covalent bond, -CH<sub>2</sub>O-, -CH<sub>2</sub>S-, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-;

Y<sub>24</sub> represents halogen; and

Y<sub>25</sub> and Y<sub>26</sub> independently represent hydrogen, halogen, alkyl, polyhaloalkyl, alkoxy, polyhaloalkoxy, cyano, alkylthio, alkylsulfinyl,

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alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that at least one of  $Y_{25}$  and  $Y_{26}$  is halogen and further provided that when  $Y_{24}$ ,  $Y_{25}$  and  $Y_{26}$  are chloro and  $X_{13}$  is O, then  $R_{27}$  is not unsubstituted phenyl;



(v)

wherein:

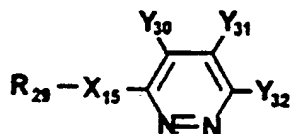
$R_{28}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{14}$  represents O, S, SO,  $SO_2$ , NH,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$  or  $-CONH-$ ;

$Y_{27}$  and  $Y_{28}$  are independently halogen;

and

$Y_{29}$  represents hydrogen, halogen, alkyl, polyhaloalkyl, alkoxy, polyhaloalkoxy, cyano, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl;



(vi)



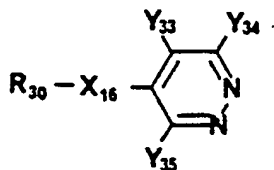
- 739 -

wherein:

$R_{29}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{15}$  represents O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, a single covalent bond, -CH<sub>2</sub>O-, -CH<sub>2</sub>S-, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-; and

$Y_{30}$ ,  $Y_{31}$  and  $Y_{32}$  independently represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that at least two of  $Y_{30}$ ,  $Y_{31}$  and  $Y_{32}$  are halogen;



(vii)

wherein:

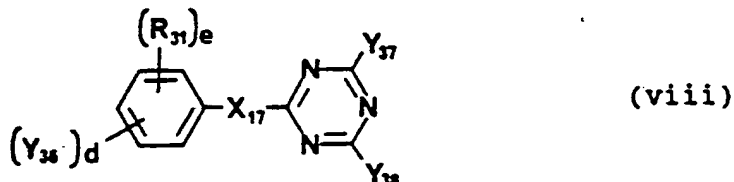
$R_{30}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{16}$  represents O, S, SO, SO<sub>2</sub>, NH, CH<sub>2</sub>, a single covalent bond, -CH<sub>2</sub>O-, -CH<sub>2</sub>S-, -CH(CH<sub>3</sub>)O-, -CH(CN)O-, -CH=NO-, -C(CH<sub>3</sub>)=NO-, -CH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>CH<sub>2</sub>-, -C≡C-, -CH<sub>2</sub>SO-, -CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-; and

$Y_{33}$ ,  $Y_{34}$  and  $Y_{35}$  independently represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, alkylthio,

- 740 -

alkylsulfanyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that (i) at least two of  $Y_{33}$ ,  $Y_{34}$  and  $Y_{35}$  are halogen, (ii) when  $Y_{34}$  and  $Y_{35}$  are both chloro and  $X_{16}$  is O, then  $R_{30}$  is not unsubstituted phenyl, and (iii) when  $Y_{33}$  and  $Y_{34}$  are both chloro and  $X_{16}$  is O, then  $R_{30}$  is not unsubstituted phenyl or 4-methoxyphenyl;



wherein:

$d$  is a value of from 0 to 4 inclusive;

$e$  is a value of 1 or 2 provided that  $d + e$  are not greater than 5;

$R_{31}$  is the same or different and represents unsubstituted or substituted aryl provided that when  $R_{31}$  is 2- or 4-aryl then  $d$  is not O; aralkyl provided that when  $R_{31}$  is 4-aralkyl then  $d$  is not O; alkoxy, cycloalkoxy, aryloxy, aralkoxy provided that when  $R_{31}$  is 4-aralkoxy then  $d$  is not O; arylaryloxy, aralkoxyaralkyl, arylaralkoxy, aryloxyaralkyl, aryloxyalkyl, aryloxyaryloxy, aralkoxyaralkoxy, aryloxyalkoxy, alkylthio, alkenylthio, arylthio, aralkylthio, arylthioaralkyl, arylsulfonylarylsulfonyl, alkylamino, dialkylamino, acyloxy, aroyloxy, alkoxycarbonyloxy, phenylazo provided that  $X_{17}$  is O or S: naphthylazo, or  $-OCH_2O-$  or  $-OCH_2CH_2O-$

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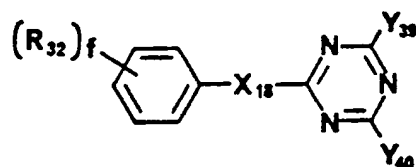
which join adjacent carbon atoms to form a five- or six-membered ring;

$Y_{36}$  is the same or different and represents halogen, alkyl, alkenyl, alkynyl,  $-\text{CH}=\text{CHCH}=\text{CH}-$  which joins adjacent carbon atoms to form a six-membered ring,  $-(\text{CH}_2)_4$ , nitro, cyano, haloalkyl, or polyhaloalkyl;

$X_{17}$  represents O, S, NH,  $\text{CH}_2$ ,  $-\text{CH}_2\text{O}-$ ,  $-\text{CH}_2\text{S}-$  or  $-\text{OCH}_2\text{CH}_2\text{O}-$ ;

$Y_{37}$  represents halogen; and

$Y_{38}$  represents halogen, alkoxy, alkylthio, alkylsulfonyl, polyhaloalkoxy, polyhaloalkyl, cyano, nitro or unsubstituted or substituted arylthio, aryloxy or arylsulfonyl;



(ix)

wherein:

$f$  is a value of from 0 to 5;

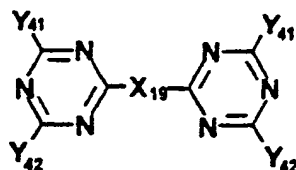
$R_{32}$  is the same or different and represents halogen, alkyl, alkenyl, alkynyl, polyhaloalkyl, cyano, nitro, alkylamino, dialkylamino, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, acyl,  $\text{CO}_2(\text{alkyl})$ ,  $\text{CONH}(\text{alkyl})$ ,  $\text{CON}(\text{alkyl})_2$ ,  $\text{SO}_2\text{N}(\text{alkyl})_2$ , alkylcarbonyloxy, alkoxycarbonyloxy, or unsubstituted or substituted aryloxy, arylthio, arylsulfonyl or aroyl;

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$X_{18}$  represents O, S,  $CH_2$ , a single covalent bond or  $-C\equiv C-$ ;

$Y_{39}$  represents halogen, polyhaloalkoxy, polyhaloalkyl, cyano, alkylsulfonyl, alkylsulfonyloxy, polyhaloalkylsulfonyl or polyhaloalkylsulfonyloxy; and

$Y_{40}$  represents haloalkyl, polyhaloalkyl, alkoxy provided that  $X_{18}$  is not S or a single covalent bond; polyhaloalkoxy, cyano, alkylthio provided that  $X_{18}$  is not O or a single covalent bond; alkylsulfonyl, nitro, dialkoxyphosphinyl or trialkylammonium;



(x)

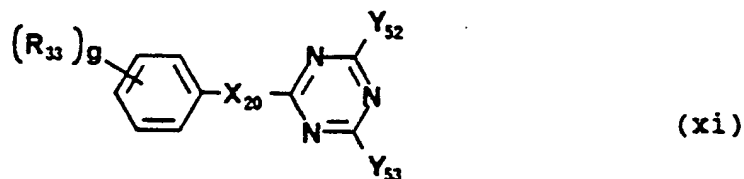
wherein:

$Y_{41}$  is the same or different and represents halogen;

$Y_{42}$  is the same or different and represents halogen, alkoxy, alkylthio or polyhaloalkoxy; and

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$X_{19}$  represents O, -S-S-,  
 -P(=O)(O-alkyl)-, -P(alkyl)-, -P(O-alkyl)-,  
 sulfinyl, sulfonyl, thiosulfinyl, a single covalent  
 bond, carbonyl, aminocarbonylamino, aminooxalyl-  
 amino, aminocarbonylalkylenecarbonylamino,  
 aminoalkyleneamino, unsubstituted or substituted  
 oxyaryloxy provided that 1,3-arylenebis(oxy) is  
 substituted with at least one substituent; oxyaryl-  
 alkylaryloxy, oxyarylthioaryloxy,  
 oxyarylsulfonylaryloxy and oxyarylaryloxy;



wherein:

$Y_{52}$  and  $Y_{53}$  are independently halogen;  
 $g$  is a value of from 0 to 5 inclusive;

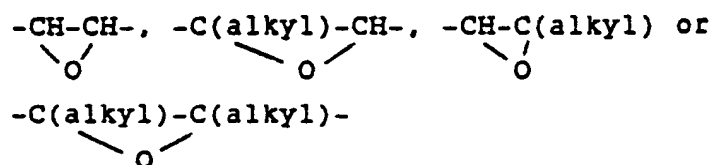
$R_{33}$  is the same or different and  
 represents halogen, alkyl, alkenyl, alkynyl,  
 polyhaloalkyl, cyano, nitro, amino, alkylamino,  
 dialkylamino, alkoxy, polyhaloalkoxy, alkylthio,  
 alkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl,  
 alkoxycarbonyl, alkylaminocarbonyl, aminocarbonyl,  
 dialkylaminocarbonyl, dialkylaminosulfonyl,  
 alkylaminosulfonyl, aminosulfonyl, alkylcarbonyl,  
 dialkoxyalkyl, alkylcarbonyloxy,  
 alkylcarbonylalkylamino, -CH=CHCH=CH- which joins  
 adjacent carbon atoms to form a six-membered ring,  
 or unsubstituted or substituted aryl, aralkyl,  
 aryloxy, arylthio, arylsulfonyl or aralkoxy; and

$X_{20}$  represents -CH(alkyl)O-,  
 -C(alkyl)<sub>2</sub>O-, -OCH<sub>2</sub>-, -CH<sub>2</sub>O-, -CH<sub>2</sub>-,

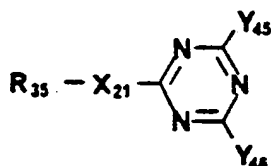
- 744 -

$-\text{C}(\text{halogen})_2$ ,  $-\text{OCH}_2\text{O}-$ ,  $-\text{OCH}_2\text{CH}_2\text{O}-$  or  $-\text{C}\equiv\text{C}-$   
 provided that g is a value of at least 1;  
 $-\text{OCH}(\text{alkyl})-$ ,  $-\text{OC}(\text{alkyl})_2$ ,  $-\text{OCH}(\text{alkyl})\text{O}-$ ,  
 $-\text{OC}(\text{alkyl})_2\text{O}-$ ,  $-\text{OCH}(\text{alkyl})\text{CH}_2\text{O}-$ ,  
 $-\text{OCH}(\text{alkyl})\text{CH}(\text{alkyl})\text{O}-$ ,  $-\text{CH}(\text{alkyl})\text{CH}(\text{alkyl})-$ ,  
 $-\text{CH}(\text{alkyl})-$ ,  $-\text{C}(\text{alkyl})_2-$ ,  $-\text{CH}_2\text{CH}_2\text{O}-$ ,  
 $-\text{OCH}_2\text{CH}_2-$ ,  $-\text{CH}(\text{alkyl})\text{CH}_2\text{O}-$ ,  $-\text{CH}_2\text{CH}_2-$ ,  
 $-\text{CH}(\text{CN})\text{O}-$ ,  $-\text{C}(\text{alkyl})(\text{CN})\text{O}-$ ,  $-\text{CH}(\text{polyhaloalkyl})\text{O}-$ ,  
 $-\text{C}(\text{CN})=\text{NO}-$ ,  $-\text{C}(\text{NH alkyl})=\text{NO}-$ ,  $-\text{C}[\text{N}(\text{alkyl})_2]=\text{NO}-$ ,  
 $-\text{C}(\text{S-alkyl})=\text{NO}-$ ,  $-\text{C}(\text{O-alkyl})=\text{NO}-$ ,  $-\text{SC}(=\text{O})\text{O}-$ ,  
 $-\text{NHC}(=\text{O})\text{O}-$ ,  $-\text{N}(\text{alkyl})\text{C}(=\text{O})\text{O}-$ ,  $\text{SO}$ ,  $\text{SO}_2$ ,  
 $-\text{CH}_2\text{S}(\text{O})_h-$ ,  $-\text{CH}(\text{alkyl})\text{S}(\text{O})_h-$ ,  $-\text{S}(\text{O})_h\text{CH}_2-$ ,  
 $-\text{OC}(=\text{S})\text{S}-$ ,  $-\text{C}(=\text{O})\text{S}-$ ,  $-\text{C}(=\text{S})\text{S}-$ ,  $-\text{NH}(\text{alkyl})\text{C}(=\text{O})\text{S}-$ ,  
 $-\text{O}(\text{C}=\text{O})\text{S}-$ ,  $-\text{N}(\text{R}_{34})-$ ,  $-\text{SO}_2\text{NH}-$ ,  $-\text{SO}_2\text{N}(\text{alkyl})-$ ,  
 $-\text{CONH}-$ ,  $-\text{CON}(\text{alkyl})-$ ,  $-\text{SC}(=\text{O})\text{N}(\text{alkyl})-$ ,  $-\text{S-C}(=\text{O})\text{NH}-$ ,  
 $-\text{NHSO}_2\text{NH}-$ ,  $-\text{N}(\text{alkyl})\text{SO}_2\text{N}(\text{alkyl})-$ ,  
 $-\text{N}(\text{alkyl})\text{SO}_2\text{NH}-$ ,  $-\text{NHSO}_2\text{N}(\text{alkyl})-$ ,  
 $-\text{C}(\text{O-alkyl})=\text{N}-$ ,  $-\text{C}(\text{S-alkyl})=\text{N}-$ ,  $-\text{CH}(\text{halogen})-$ ,  
 $-\text{C}(\text{alkyl})(\text{halogen})$ ,  $-\text{CH}(\text{CN})-$ ,  $-\text{C}(\text{alkyl})(\text{CN})-$ ,  
 $-\text{NH}(\text{alkyl})\text{NH}-$ ,  $-\text{NH-N}(\text{alkyl})-$ ;  $-\text{NH-NH}-$  or  $-\text{N=N}-$   
 provided that  $\text{R}_{33}$  is not nitro;  $-\text{C}(=\text{O})-$ ,  
 $-\text{C}(=\text{O})\text{C}(=\text{O})-$ ,  $-\text{CH}(\text{O-alkyl})-$ ,  $-\text{CH}_2\text{C}(=\text{O})-$ ,  
 $-\text{C}(=\text{O})\text{CH}_2$ ,  $-\text{CH}(\text{alkyl})\text{C}(=\text{O})-$ ,  $-\text{C}(=\text{O})\text{CH}(\text{alkyl})-$ ,  
 $-\text{CH}=\text{CH}-$ ,  $-\text{C}(\text{alkyl})=\text{CH}-$ ,  $-\text{CH}=\text{C}(\text{alkyl})-$ ,  
 $-\text{C}(\text{alkyl})=\text{C}(\text{alkyl})-$ ,  $-\text{C}(=\text{O})\text{CH}=\text{CH}-$ ,  
 $-\text{P}(\text{Y}_{43})(\text{Y}_{44}-\text{alkyl})-$ , unsubstituted or  
 substituted  $-\text{P}(\text{Y}_{43})(\text{Y}_{44}-\text{aryl})$  or arylene,  
 $-\text{Si}(\text{halogen})_2-$ ,  $-\text{Si}(\text{alkyl})_2$ ,  $-\text{OC}(=\text{O})\text{N}(\text{alkyl})-$ ,  
 $-\text{OCH}_2\text{C}(=\text{O})\text{N}(\text{alkyl})-$ ,  $-\text{N}(\text{alkyl})\text{CON}(\text{alkyl})-$ ;  
 $-\text{OC}(=\text{O})\text{NH}-$ ,  $-\text{NHCONH}-$ ,  $-\text{SO}_2\text{NHC}(=\text{O})\text{NH}-$ , or  
 $-\text{NHC}(=\text{S})\text{NH}$  provided that g is a value of at least 1;

- 745 -



wherein h is a value of from 0 to 2 inclusive,  $R_{34}$  represents acyl, alkylsulfonyl, polyhaloalkyl, polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted or substituted aroyl or arylsulfonyl and  $Y_{43}$  and  $Y_{44}$  are independently O or S;



(xii)

wherein:

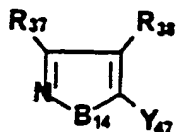
$R_{35}$  represents an unsubstituted or substituted heterocyclic ring system selected from isoxazole, isothiazole, pyrazole, imidazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,4,-thiadiazole, 1,3,4-thiadiazole, oxazole, thiazole, benzopyrazole, benzimidazole, benzoxazole, benzothiazole, indole, pyrrole, furan, thiophene, benzofuran, benzothiophene, pyridine, pyrimidine, pyridazine, pyrazine, 1,3,5-triazine, 1,2,4-triazine, quinoline, isoquinoline, quinazoline, phthalazine, benzopyridazine, benzopyrazine, carbazole, dibenzofuran, dibenzothiophene, benzoxazine, phthalimide, benzopyran, dibenzopyridine, pyridopyridine, pyrazolopyrimidine, tetrahydropyrimidinedione, coumarin, piperidine, morpholine, tetrahydrofuran,

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tetrahydrothiophene, pyrrolidine, thiomorpholine,  
 piperidine-2-one, piperidine-2,6-dione,  
 2,5-pyrrolidinedione, 3-morpholinone,  
 2-oxohexamethyleneimine, 2-oxotetramethyleneimine,  
 1-pyrazoline, 2-pyrazoline, pyrazolidine,  
 2-imidazolidinone, 2-imidazolidinethione,  
 2,4-imidazolidinedione, 1,2-oxathiolane,  
 1,3-oxathiolane, 1,3-oxathiane, 1,4-oxathiane,  
 2(1H)-pyrazinone, 2H-pyran-2-one, 4H-pyran-4-one,  
 2H-pyran-2-thione, 4H-pyran-4-thione,  
 tetrahydropyran, tetrahydrothiopyran,  
 7-oxabicyclo[2.2.1]heptane,  
 7-azabicyclo[2.2.1]heptane, oxetane, coumarin,  
 1,3-dioxane, 1,4-dioxane or 1,3-dioxolane;

$X_{21}$  represents O, S or NH provided that  
 when  $X_{21}$  is NH then  $R_{35}$  is not pyridine, and  
 when  $X_{21}$  is S then  $R_{35}$  is not unsubstituted  
 benzothiazole; and

$Y_{45}$  and  $Y_{46}$  are independently halogen;

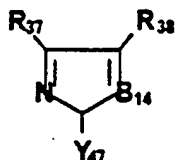


(xiii)

or



- 747 -



(xiv)

wherein:

$R_{37}$  and  $R_{38}$  independently represent halogen, nitro, cyano, polyhaloalkyl, polyhaloalkoxy, alkylsulfonyl, polyhaloalkylsulfonyl, acyl, alkoxycarbonyl, polyhaloalkylsulfonyl or  $R_{39}-X_{22}-$  provided that only one of  $R_{37}$  and  $R_{38}$  may be  $R_{39}-X_{22}-$  at any one time;

$R_{39}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

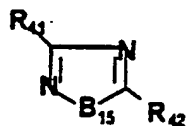
$X_{22}$  represents O, S, SO,  $SO_2$ ,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$  or  $-CONH-$ ;

$Y_{47}$  represents halogen; and

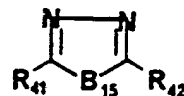
$B_{14}$  represents O, S, NH or  $NR_{40}$  wherein  $R_{40}$  represents alkyl, alkylsulfonyl, alkenyl, alkynyl, alkoxycarbonyl; unsubstituted or substituted aryl, aralkyl, aryloxy, arylamino, aroyl or arylsulfonyl; provided that (i) when  $B_{14}$  is

- 748 -

$R_{39}-N<$ ,  $R_{39}-alkyl-N<$ ,  $R_{39}-C(=O)-N<$ ,  
 $R_{39}-SO_2N<$ ,  $R_{39}-O-N<$  or  $R_{39}-NH-N<$ , then both  
 $R_{37}$  and  $R_{38}$  are other than  $R_{39}-X_{22}-$ ; (ii)  
when  $B_{14}$  is other than  $R_{39}-N<$ ,  $R_{39}-alkyl-N<$ ,  
 $R_{39}-C(=O)-N<$ ,  $R_{39}-SO_2N<$ ,  $R_{39}-O-N<$  or  
 $R_{39}-NH-N<$ , then one of  $R_{37}$  and  $R_{38}$  is  
 $R_{39}-X_{22}-$ ; and (iii) when  $R_{38}$  and  $Y_{47}$  are  
both chlorine and  $X_{22}$  is a single covalent bond in  
formula (xiii), then  $R_{39}$  is not unsubstituted  
phenyl;



(xv)



(xvi)

wherein:

$R_{41}$  and  $R_{42}$  independently represent  
halogen or  $R_{43}-X_{23}-$  provided that only one of  
 $R_{41}$  and  $R_{42}$  may be  $R_{43}-X_{23}-$  at any one time;

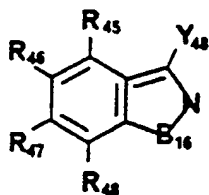
$R_{43}$  represents unsubstituted or  
substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{23}$  represents O, S, SO,  $SO_2$ ,  $CH_2$ , a  
single covalent bond,  $-CH_2O-$ ,  $CH_2S-$ ,  
 $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  
 $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,

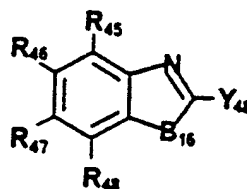
- 749 -

-CH<sub>2</sub>SO<sub>2</sub>-, -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH(alkyl)- or -CONH-;  
and

B<sub>15</sub> represents O, S, NH or NR<sub>44</sub> wherein R<sub>44</sub> represents alkyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkenyl, alkynyl, alkoxycarbonyl; unsubstituted or substituted aryl, aralkyl, aryloxy, arylamino, aroyl or arylsulfonyl; provided that when B<sub>15</sub> is R<sub>43</sub>-N<, R<sub>43</sub>-alkyl-N<, R<sub>43</sub>-C(=O)-N<, R<sub>43</sub>-SO<sub>2</sub>N<, R<sub>43</sub>-O-N< or R<sub>43</sub>-NH-N<, then both R<sub>41</sub> and R<sub>42</sub> are other than R<sub>43</sub>-X<sub>23</sub>-; and further provided that when B<sub>15</sub> is other than R<sub>43</sub>-N<, R<sub>43</sub>-alkyl-N<, R<sub>43</sub>-C(=O)-N<, R<sub>43</sub>-SO<sub>2</sub>N<, R<sub>43</sub>-O-N< or R<sub>43</sub>-NH-N<, then one of R<sub>41</sub> and R<sub>42</sub> is R<sub>43</sub>-X<sub>23</sub>-;



(xvii)



(xviii)

wherein:

R<sub>45</sub>, R<sub>46</sub>, R<sub>47</sub>, and R<sub>48</sub> independently represent hydrogen, halogen, nitro, cyano, polyhaloalkyl, polyhaloalkoxy, alkylsulfonyl, polyhaloalkylsulfonyl, acyl, alkylthio, alkyl, alkoxy, alkylsulfinyl or R<sub>49</sub>-X<sub>24</sub>- provided that one of R<sub>45</sub>, R<sub>46</sub>, R<sub>47</sub>, and R<sub>48</sub> is R<sub>49</sub>-X<sub>24</sub>- and further provided that R<sub>45</sub>, R<sub>46</sub>,

- 750 -

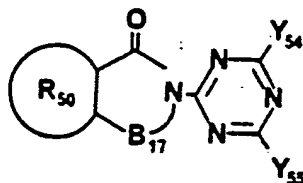
$R_{47}$ , and  $R_{48}$  include no more than two of hydrogen, alkyl or alkoxy at any one time;

$R_{49}$  represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

$X_{24}$  represents O, S, SO,  $SO_2$ ,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-CH(alkyl)-$  or  $-CONH-$ ;

$Y_{48}$  represents halogen; and

$B_{16}$  represents O, S or NH;



(xix)

wherein:

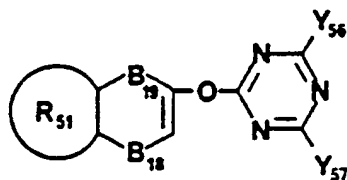
$R_{50}$  represents an unsubstituted or substituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated;

$B_{17}$  represents  $-CH=N-$ ,  $-N=CH-$ ,  $-CH=CH-$ ,  $-CO-$ ,  $-SO_2-$ ,  $-CH_2CO-$ ,  $-COCH_2-$ ,  $-CONH-$ ,  $-NHCO-$ ,  $-SO_2NH-$ ,  $-NHSO_2-$ ,  $-SO_2N(alkyl)-$ ,  $-N(alkyl)SO_2-$ ,  $-OSO_2-$ ,  $-CS-$ ,  $-N<$ ,  $-NH-$ ,

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-N(alkyl)-, -OCH<sub>2</sub>-, -SCH<sub>2</sub>-, -NHCH<sub>2</sub>-,  
 -N(alkyl)CH<sub>2</sub>-, -SCO-, -OCH<sub>2</sub>-, -OCO-, -CH<sub>2</sub>-,  
 -CH<sub>2</sub>CH<sub>2</sub>- or -SCH<sub>2</sub>CO-; provided that when B<sub>17</sub>  
 is -CO- and R<sub>50</sub> is phenyl, then the phenyl is  
 substituted; and

Y<sub>54</sub> and Y<sub>55</sub> are independently halogen;



(xx)

wherein:

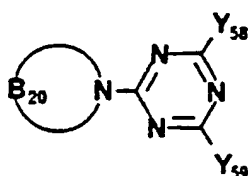
R<sub>51</sub> represents or unsubstituted or substituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated;

B<sub>18</sub> represents -CH=N-, -N=CH-, -CH=CH-,  
 -CO-, -SO<sub>2</sub>-, -CH<sub>2</sub>CO-, -COCH<sub>2</sub>-, -CONH-, -NHCO-,  
 -SO<sub>2</sub>NH-, -NHSO<sub>2</sub>-, -SO<sub>2</sub>N(alkyl)-,  
 -N(alkyl)SO<sub>2</sub>-, -OSO<sub>2</sub>-, -CS-, -N<,  
 -NH-, -N(alkyl)-, -OCH<sub>2</sub>-, -SCH<sub>2</sub>-, -NHCH<sub>2</sub>-,  
 -N(alkyl)CH<sub>2</sub>-, -S-CO-, -OCH<sub>2</sub>-, -OCO-, -CH<sub>2</sub>-,  
 -CH<sub>2</sub>CH<sub>2</sub>- or -SCH<sub>2</sub>CO-;

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$B_{19}$  represents  $-\text{CH}_2-$  or  $-\text{CH}(\text{alkyl})-$ ;  
and  $i$  is a value of 0 or 1; and

$Y_{56}$  and  $Y_{57}$  are independently halogen;



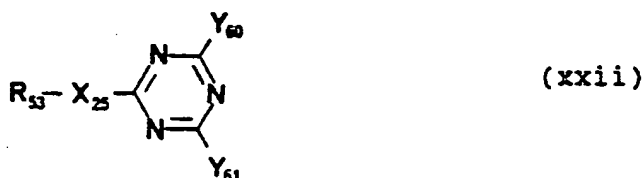
(xxi)

wherein:

$B_{20}$  represents  $-\text{CH}_2\text{C}(\text{CH}_3)_2\text{SCH}_2-$ ,  
 $-\text{CH}_2\text{CH}=\text{C}(\text{CH}_3)\text{OCH}_2-$ ,  $-\text{CH}_2\text{CH}_2\text{SCH}_2\text{CH}(\text{CH}_3)-$ ,  
 $-\text{CH}_2\text{CH}_2\text{SCH}_2\text{CH}_2-$ ,  $-\text{CH}_2\text{SCH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2\text{CO}-$ ,  
 $-\text{CONH}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2\text{CO}-$ ,  $-\text{COC}(\text{CH}_3)_2\text{NHCO}-$ ,  
 $-\text{CH}_2\text{CH}_2\text{N}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$ ,  
 $-\text{CH}_2\text{N}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$ ,  
 $-\text{CH}_2\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$ ,  $-\text{CO}(\text{CH}_2)_3\text{CO}-$ ,  
 $-\text{CO}(\text{CH}_2)_2\text{CO}-$ ,  $-\text{COCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CO}-$ ,  
 $-\text{COCH}(\text{CH}_3)\text{CH}_2\text{CO}-$ ,  $-\text{COC}(\text{CH}_3)_2\text{CH}_2\text{CO}-$ ,  
 $-\text{COC}(\text{CH}_3)_2\text{C}(\text{CH}_3)_2\text{CO}-$ ,  $-\text{CO}(\text{CH}_2)_4\text{CO}-$ ,  
 $-\text{CO}(\text{CH}_2)_5\text{CO}-$ ,  $-\text{CO}(\text{CH}_2)_5\text{CH}_2-$ ,  
 $-\text{CO}(\text{CH}_2)_4\text{CH}_2-$ ,  $-\text{CO}(\text{CH}_2)_3\text{CH}_2-$ ,  
 $-\text{CO}(\text{CH}_2)_2\text{CH}_2-$ ,  $-\text{COCH}_2\text{SCH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{N}(\text{R}_{52})\text{CH}_2\text{CO}-$ ,  $-\text{COCH}_2\text{OCH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{SCS}-$ ,  $-\text{COCH}=\text{CH}-\text{N}=\text{CH}-$ ,  
 $-\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2-\text{N}=\text{CH}-$ , or  $-\text{CO}_2-\text{CH}_2\text{CH}_2-$ ;

- 753 -

$R_{52}$  represents hydrogen, alkenyl;  
 unsubstituted or substituted aryl or alkaryl; and  
 $Y_{58}$  and  $Y_{59}$  are independently halogen;



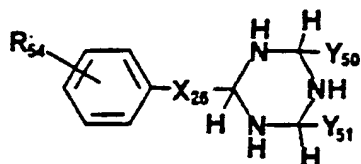
wherein:

$R_{53}$  represents unsubstituted or substituted cycloalkenyl, cycloalkadienyl, cycloalkatrienyl, bicycloalkyl, bicycloalkenyl, bicycloalkadienyl, tricycloalkyl, tricycloalkenyl or tricycloalkadienyl in which the permissible substituents are the same or different and are one or more alkyl, halogen, haloalkyl, polyhaloalkyl, alkoxy, alkylthio, alkylsulfonyl, polyhaloalkoxy, nitro, cyano, acyl, aroyl, aryl, alkoxy-carbonyl, alkoxy-carbonyloxy, acyloxy, oxo, or  $-\text{CH}=\text{CHCH}=\text{CH}-$  or  $-\text{CH}=\text{CHCH}_2-$  which join adjacent carbon atoms to form a six- or five membered ring;

$Y_{60}$  and  $Y_{61}$  are independently halogen;  
 and

$X_{25}$  represents O, S, NH,  $\text{CH}_2$ ,  $-\text{CH}_2\text{O}-$  or a single covalent bond;

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(xxiii)

wherein:

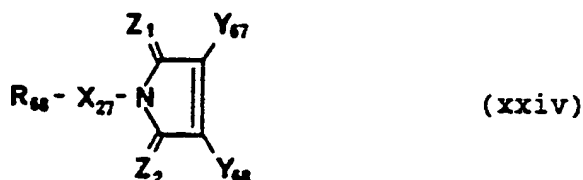
$R_{54}$  is the same or different and is one or more hydrogen, halogen, alkyl, aryl, aralkyl, alkenyl, alkynyl, polyhaloalkyl,  $NH_2$ ,  $NH(alkyl)$ ,  $N(alkyl)_2$ , alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, aralkoxy,  $CO_2alkyl$ ,  $CONH(alkyl)$ ,  $CONH_2$ ,  $CON(alkyl)_2$ ,  $SO_2N(alkyl)_2$ ,  $SO_2NH(alkyl)$ ,  $SO_2NH_2$ , acyl,  $CO(O-alkyl)_2$ , acyloxy, acyl- $CON(alkyl)$ , or 2,3- $(-CH=CHCH=CH-)$ , 3,4- $(-CH=CHCH=CH-)$ , 2,3- $(CH_2)_4-$  or 3,4- $(CH_2)_4-$  which join the adjacent carbon atoms to form an unsubstituted or substituted six-membered ring;

$X_{26}$  represents O, S, SO,  $SO_2$ ,  $CH_2$ , a single covalent bond,  $-CH_2O-$ ,  $-CH_2S-$ ,  $-CH(CH_3)O-$ ,  $-CH(CN)O-$ ,  $-CH=NO-$ ,  $-C(CH_3)=NO-$ ,  $-CH_2CH_2O-$ ,  $-CH_2CH_2-$ ,  $-C\equiv C-$ ,  $-CH_2SO-$ ,  $-CH_2SO_2-$ ,  $-OCH_2CH_2O-$ ,  $-OCH_2CH_2-$  or  $-OCH_2-$ ; and

$Y_{50}$  and  $Y_{51}$  are the same or different and are halogen;



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$R_{68}$  represents unsubstituted or substituted phenyl or 1- or 2-naphthyl;

$X_{27}$  represents -CH(alkyl)O-,  
 -C(alkyl)<sub>2</sub>O-, -OCH<sub>2</sub>-, -C(halogen)<sub>2</sub>-, -OCH<sub>2</sub>O-,  
 -OCH<sub>2</sub>CH<sub>2</sub>O-, -CH<sub>2</sub>O-, -C≡C-, -OCH(alkyl)-,  
 -OC(alkyl)<sub>2</sub>-, -OCH(alkyl)O-, -OC(alkyl)<sub>2</sub>O-,  
 -OCH(alkyl)CH<sub>2</sub>O-, -OCH(alkyl)CH(alkyl)O-,  
 -CH(alkyl)CH(alkyl)-, -CH(alkyl)-, -C(alkyl)<sub>2</sub>-,  
 -CH<sub>2</sub>CH<sub>2</sub>O-, -OCH<sub>2</sub>CH<sub>2</sub>-, -CH(alkyl)CH<sub>2</sub>O-,  
 -CH<sub>2</sub>CH<sub>2</sub>-, -CH(CN)O-, -C(alkyl)(CN)O-,  
 -CH(polyhaloalkyl)O-, -C(CN)=NO-, -C(NH alkyl)=NO-,  
 -C[N(alkyl)<sub>2</sub>]=NO-, -C(S-alkyl)=NO-,  
 -C(O-alkyl)=NO-, -SC(=O)O-, -NHC(=O)O-,  
 -N(alkyl)C(=O)O-, SO, SO<sub>2</sub>, -CH<sub>2</sub>S(O)<sub>h</sub>-,  
 -CH(alkyl)S(O)<sub>h</sub>-, -S(O)<sub>h</sub>CH<sub>2</sub>-, -OC(=S)S-,  
 -C(=O)S-, -C(=S)-S-, -NH(alkyl)C(=O)S-, -O(C=O)S-,  
 -N(alkyl)-, -N(R<sub>34</sub>)-, -SO<sub>2</sub>NH-, -SO<sub>2</sub>N(alkyl)-,  
 -CONH-, -CON(alkyl)-, -SC(=O)N(alkyl)-, -S-C(=O)NH-,  
 -NHSO<sub>2</sub>NH-, -N(alkyl)SO<sub>2</sub>N(alkyl)-,  
 -N(alkyl)SO<sub>2</sub>NH-, -NHSO<sub>2</sub>N(alkyl)-,  
 -C(O-alkyl)=N-, -C(S-alkyl)=N-, -CH(halogen)-,  
 -C(alkyl)(halogen)-, -CH(CN)-, -C(alkyl)(CN)-,  
 -NH(alkyl)NH-, -NH-N(alkyl)-; -NH-NH-, -N=N-,  
 -C(=O)-, -C(=O)C(=O)-, -CH(O-alkyl)-, -CH<sub>2</sub>C(=O)-,  
 -C(=O)CH<sub>2</sub>-, -CH(alkyl)C(=O)-, -C(=O)CH(alkyl)-,

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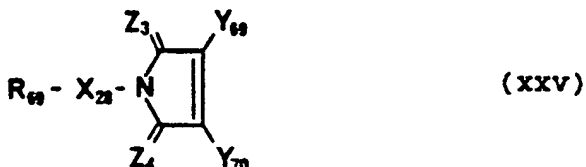
$-\text{CH}=\text{CH}-$ ,  $-\text{C}(\text{alkyl})=\text{CH}-$ ,  $-\text{CH}=\text{C}(\text{alkyl})-$ ,  
 $-\text{C}(\text{alkyl})=\text{C}(\text{alkyl})-$ ,  $-\text{C}(=\text{O})\text{CH}=\text{CH}-$ ,  
 $-\text{P}(\text{Y}_{43})(\text{Y}_{44}-\text{alkyl})-$ , unsubstituted or  
substituted  $-\text{P}(\text{Y}_{43})(\text{Y}_{44}-\text{aryl})$  or arylene,  
 $-\text{Si}(\text{halogen})_2-$ ,  $-\text{Si}(\text{alkyl})_2-$ ,  $-\text{OC}(=\text{O})\text{N}(\text{alkyl})-$ ,  
 $-\text{OCH}_2\text{C}(=\text{O})\text{N}(\text{alkyl})-$ ,  $-\text{N}(\text{alkyl})\text{CON}(\text{alkyl})-$ ;  
 $-\text{OC}(=\text{O})\text{NH}-$ ,  $-\text{NHCONH}-$ ,  $-\text{SO}_2\text{NHC}(=\text{O})\text{NH}-$ ,  $-\text{NHC}(=\text{S})\text{NH}-$ ,  
 $-\text{CH}-\text{CH}-$ ,  $-\text{C}(\text{alkyl})-\text{CH}-$ ,  $-\text{CH}-\text{C}(\text{alkyl})-$  or  
 $-\text{C}(\text{alkyl})-\text{C}(\text{alkyl})-$ .

wherein  $h$  is a value of from 0 to 2 inclusive,  $\text{R}_{34}$   
represents acyl, alkylsulfonyl, polyhaloalkyl,  
polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted  
or substituted aroyl or arylsulfonyl and  $\text{Y}_{43}$  and  
 $\text{Y}_{44}$  are independently O or S;

$\text{Z}_1$  and  $\text{Z}_2$  are independently O, S,  
 $\text{C}_1-\text{C}_8$  alkylidene, substituted or unsubstituted  
benzylidene, NH or  $\text{NR}'$  wherein  $\text{R}'$  is alkyl,  
aryl, aralkyl, alkenyl or alkynyl; and

$\text{Y}_{67}$  and  $\text{Y}_{68}$  are the same or different  
and represent hydrogen, halogen, alkyl, cyano,  
polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl,  
alkylthio, alkylsulfinyl, alkylsulfonyl, nitro,  
aryl, polyhaloalkylsulfonyl, alkylamino,  
dialkylamino, acylamino, acyloxy, alkylsulfonyloxy,  
arylsulfonyloxy, alkenylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
phosphono or phosphino;

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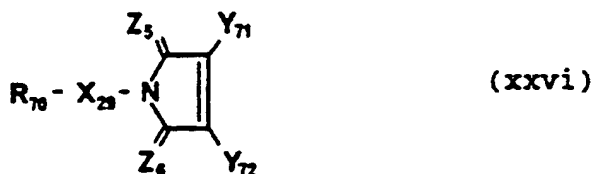


$R_{69}$  represents unsubstituted or substituted phenyl or 1- or 2-naphthyl;

$X_{28}$  is  $NH$ ,  $CH_2$  or a covalent bond;

$Z_3$  and  $Z_4$  are independently O, S,  $C_1-C_8$  alkylidene, substituted or unsubstituted benzylidene,  $NH$  or  $NR'''$  wherein  $R'''$  is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

$Y_{69}$  and  $Y_{70}$  are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, aryl, polyhaloalkylsulfonyl, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, phosphono or phosphino, with the proviso that  $Y_{69}$  and  $Y_{70}$  taken together do not represent either the same halogen or halogen and hydrogen;



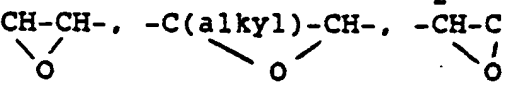
$R_{70}$  represents an unsubstituted or substituted, unsaturated or saturated, aromatic or non-aromatic heterocyclic ring system selected from

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isoxazole, isothiazole, pyrazole, imidazole,  
 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole,  
 1,2,4,-thiadiazole, 1,3,4-thiadiazole, oxazole,  
 thiazole, benzopyrazole, benzimidazole, benzoxazole,  
 benzothizole, indole, pyrrole, furan, thiophene,  
 benzofuran, benzothiophene, pyridine, pyrimidine,  
 pyridazine, pyrazine, 1,3,5-triazine,  
 1,2,4-triazine, quinoline, isoquinoline,  
 quinazoline, phthalazine, benzopyridazine,  
 benzopyrazine, carbazole, dibenzofuran,  
 dibenzothiophene, benzoxazine, phthalimide,  
 benzopyran, dibenzopyridine, pyridopyridine,  
 pyrazolopyrimidine, tetrahydropyrimidinedione,  
 piperidine, morpholine, tetrahydrofuran,  
 tetrahydrothiophene, pyrrolidine, thiomorpholine,  
 piperidine-2-one, piperidine-2,6-dione,  
 2,5-pyrrolidinedione, 3-morpholinone,  
 2-oxohexamethyleneimine, 2-oxotetramethyleneimine,  
 1-pyrazoline, 2-pyrazoline, pyrazolidine,  
 2-imidazolidinone, 2-imidazolidinethione,  
 2,4-imidazolidinedione, 1,2-oxathiolane,  
 1,3-oxathiolane, 1,3-oxathiane, 1,4-oxathiane,  
 2(1H)-pyrazinone, 2H-pyran-2-one, 4H-pyran-4-one,  
 2H-pyran-2-thione, 4H-pyran-4-thione,  
 tetrahydropyran, tetrahydrothiopyran,  
 7-oxabicyclo[2.2.1]heptane,  
 7-azabicyclo[2.2.1]heptane, oxetane, coumarin,  
 1,3-dioxane, 1,4-dioxane or 1,3-dioxolane;

$X_{29}$  represents -CH(alkyl)O-,  
 -C(alkyl)<sub>2</sub>O-, -OCH<sub>2</sub>-, -CH<sub>2</sub>O-, -CH<sub>2</sub>-, a  
 covalent bond, -C(halogen)<sub>2</sub>-, -OCH<sub>2</sub>O-,  
 -OCH<sub>2</sub>CH<sub>2</sub>O-, -C≡C-, -OCH(alkyl)-, -OC(alkyl)<sub>2</sub>.

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$\text{-OCH(alkyl)O-}$ ,  $\text{-OC(alkyl)}_2\text{O-}$ ,  $\text{-OCH(alkyl)CH}_2\text{O-}$ ,  
 $\text{-OCH(alkyl)CH(alkyl)O-}$ ,  $\text{-CH(alkyl)CH(alkyl)-}$ ,  
 $\text{-CH(alkyl)-}$ ,  $\text{-C(alkyl)}_2\text{-}$ ,  $\text{-CH}_2\text{CH}_2\text{O-}$ ,  
 $\text{-OCH}_2\text{CH}_2\text{-}$ ,  $\text{-CH(alkyl)CH}_2\text{O-}$ ,  $\text{-CH}_2\text{CH}_2\text{-}$ ,  
 $\text{-CH(CN)O-}$ ,  $\text{-C(alkyl)(CN)O-}$ ,  $\text{-CH(polyhaloalkyl)O-}$ ,  
 $\text{-C(CN)=NO-}$ ,  $\text{-C(NH alkyl)=NO-}$ ,  $\text{-C[N(alkyl)}_2\text{]=NO-}$ ,  
 $\text{-C(S-alkyl)=NO-}$ ,  $\text{-C(O-alkyl)=NO-}$ ,  $\text{-SC(=O)O-}$ ,  
 $\text{-NHC(=O)O-}$ ,  $\text{-N(alkyl)C(=O)O-}$ ,  $\text{SO}$ ,  $\text{SO}_2$ ,  
 $\text{-CH}_2\text{S(O)}_h\text{-}$ ,  $\text{-CH(alkyl)S(O)}_h\text{-}$ ,  $\text{-S(O)}_h\text{CH}_2\text{-}$ ,  
 $\text{-OC(=S)S-}$ ,  $\text{-C(=O)S-}$ ,  $\text{-C(=S)S-}$ ,  $\text{-NH(alkyl)C(=O)S-}$ ,  
 $\text{-O(C=O)S-}$ ,  $\text{-NH-}$ ,  $\text{-N(alkyl)-}$ ,  $\text{-N(R}_{34}\text{)-}$ ,  $\text{-SO}_2\text{NH-}$ ,  
 $\text{-SO}_2\text{N(alkyl)-}$ ,  $\text{-CONH-}$ ,  $\text{-CON(alkyl)-}$ ,  
 $\text{-SC(=O)N(alkyl)-}$ ,  $\text{-S-C(=O)NH-}$ ,  $\text{-NHSO}_2\text{NH-}$ ,  
 $\text{-N(alkyl)SO}_2\text{N(alkyl)-}$ ,  $\text{-N(alkyl)SO}_2\text{NH-}$ ,  
 $\text{-NHSO}_2\text{N(alkyl)-}$ ,  $\text{-C(O-alkyl)=N-}$ ,  $\text{-C(S-alkyl)=N-}$ ,  
 $\text{-CH(halogen)-}$ ,  $\text{-C(alkyl)(halogen)-}$ ,  $\text{-CH(CN)-}$ ,  
 $\text{-C(alkyl)(CN)-}$ ,  $\text{-NH(alkyl)NH-}$ ,  $\text{-NH-N(alkyl)-}$ ;  
 $\text{-NH-NH-}$ ,  $\text{-N=N-}$ ,  $\text{-C(=O)-}$ ,  $\text{-C(=O)C(=O)-}$ ,  
 $\text{-CH(O-alkyl)-}$ ,  $\text{-CH}_2\text{C(=O)-}$ ,  $\text{-C(=O)CH}_2\text{-}$ ,  
 $\text{-CH(alkyl)C(=O)-}$ ,  $\text{-C(=O)CH(alkyl)-}$ ,  $\text{-CH=CH-}$ ,  
 $\text{-C(alkyl)=CH-}$ ,  $\text{-CH=C(alkyl)-}$ ,  $\text{-C(alkyl)=C(alkyl)-}$ ,  
 $\text{-C(=O)CH=CH-}$ ,  $\text{-P(Y}_{43}\text{)(Y}_{44}\text{-alkyl)-}$ , unsubstituted  
or substituted  $\text{-P(Y}_{43}\text{)(Y}_{44}\text{-aryl)}$  or arylene,  
 $\text{-Si(halogen)}_2\text{-}$ ,  $\text{-Si(alkyl)}_2\text{-}$ ,  $\text{-OC(=O)N(alkyl)-}$ ,  
 $\text{-OCH}_2\text{C(=O)N(alkyl)-}$ ,  $\text{-N(alkyl)CON(alkyl)-}$ ;  
 $\text{-OC(=O)NH-}$ ,  $\text{-NHCONH-}$ ,  $\text{-SO}_2\text{NHC(=O)NH-}$ ,  $\text{-NHC(=S)NH-}$ ,  
 $\text{-CH-CH-}$ ,  $\text{-C(alkyl)-CH-}$ ,  $\text{-CH-C(alkyl)-}$  or  
  
 $\text{-C(alkyl)-C(alkyl)-}$ ,  

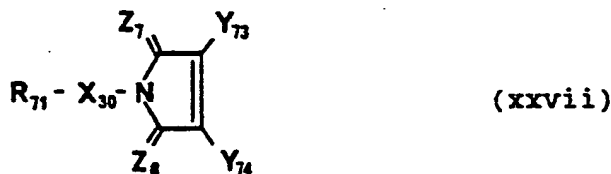

wherein  $h$  is a value of from 0 to 2 inclusive,  $R_{34}$   
represents acyl, alkylsulfonyl, polyhaloalkyl.

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polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted or substituted aroyl or arylsulfonyl and  $Y_{43}$  and  $Y_{44}$  are independently O or S;

$Z_5$  and  $Z_6$  are independently O, S,  $C_1-C_8$  alkylidene, substituted or unsubstituted benzylidene, NH or  $NR'''$  wherein  $R'''$  is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

$Y_{71}$  and  $Y_{72}$  are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl, amino, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, alkoxycarbonyl, alkylaminocarbonyl, aminocarbonyl, dialkylaminocarbonyl, dialkylaminosulfonyl, alkylaminosulfonyl, aminosulfonyl, dialkoxyalkyl, arylsulfonyl, phosphono or phosphino;



$R_{71}$  represents unsubstituted or substituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkadienyl, cycloalkatrienyl, bicycloalkyl, bicycloalkenyl, bicycloalkadienyl, tricycloalkyl, tricycloalkenyl or tricycloalkadienyl;

$X_{30}$  represents  $-CH(alkyl)O-$ ,  $-C(alkyl)_2O-$ ,  $-OCH_2-$ ,  $-CH_2O-$ ,  $-CH_2-$ , a covalent bond,  $-C(halogen)_2$ ,  $-OCH_2O-$ ,  $-OCH_2CH_2O-$ ,  $-C\equiv C-$ ,  $-OCH(alkyl)-$ ,  $-OC(alkyl)_2$ ,

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$\text{-OCH(alkyl)O-}$ ,  $\text{-OC(alkyl)}_2\text{O-}$ ,  $\text{-OCH(alkyl)CH}_2\text{O-}$ ,  
 $\text{-OCH(alkyl)CH(alkyl)O-}$ ,  $\text{-CH(alkyl)CH(alkyl)-}$ ,  
 $\text{-CH(alkyl)-}$ ,  $\text{-C(alkyl)}_2\text{-}$ ,  $\text{-CH}_2\text{CH}_2\text{O-}$ ,  
 $\text{-OCH}_2\text{CH}_2\text{-}$ ,  $\text{-CH(alkyl)CH}_2\text{O-}$ ,  $\text{-CH}_2\text{CH}_2\text{-}$ ,  
 $\text{-CH(CN)O-}$ ,  $\text{-C(alkyl)(CN)O-}$ ,  $\text{-CH(polyhaloalkyl)O-}$ ,  
 $\text{-C(CN)=NO-}$ ,  $\text{-C(NH alkyl)=NO-}$ ,  $\text{-C[N(alkyl)}_2\text{]=NO-}$ ,  
 $\text{-C(S-alkyl)=NO-}$ ,  $\text{-C(O-alkyl)=NO-}$ ,  $\text{-SC(=O)O-}$ ,  
 $\text{-NHC(=O)O-}$ ,  $\text{-N(alkyl)C(=O)O-}$ ,  $\text{SO}$ ,  $\text{SO}_2$ ,  
 $\text{-CH}_2\text{S(O)}_h\text{-}$ ,  $\text{-CH(alkyl)S(O)}_h\text{-}$ ,  $\text{-S(O)}_h\text{CH}_2\text{-}$ ,  
 $\text{-OC(=S)S-}$ ,  $\text{-C(=O)S-}$ ,  $\text{-C(=S)S-}$ ,  $\text{-NH(alkyl)C(=O)S-}$ ,  
 $\text{-O(C=O)S-}$ ,  $\text{-NH-}$ ,  $\text{-N(alkyl)-}$ ,  $\text{-N(R}_{34}\text{)-}$ ,  $\text{-SO}_2\text{NH-}$ ,  
 $\text{-SO}_2\text{N(alkyl)-}$ ,  $\text{-CONH-}$ ,  $\text{-CON(alkyl)-}$ ,  
 $\text{-SC(=O)N(alkyl)-}$ ,  $\text{-S-C(=O)NH-}$ ,  $\text{-NHSO}_2\text{NH-}$ ,  
 $\text{-N(alkyl)SO}_2\text{N(alkyl)-}$ ,  $\text{-N(alkyl)SO}_2\text{NH-}$ ,  
 $\text{-NHSO}_2\text{N(alkyl)-}$ ,  $\text{-C(O-alkyl)=N-}$ ,  $\text{-C(S-alkyl)=N-}$ ,  
 $\text{-CH(halogen)-}$ ,  $\text{-C(alkyl)(halogen)-}$ ,  $\text{-CH(CN)-}$ ,  
 $\text{-C(alkyl)(CN)-}$ ,  $\text{-NH(alkyl)NH-}$ ,  $\text{-NH-N(alkyl)-}$ ;  
 $\text{-NH-NH-}$ ,  $\text{-N=N-}$ ,  $\text{-C(=O)-}$ ,  $\text{-C(=O)C(=O)-}$ ,  
 $\text{-CH(O-alkyl)-}$ ,  $\text{-CH}_2\text{C(=O)-}$ ,  $\text{-C(=O)CH}_2\text{-}$ ,  
 $\text{-CH(alkyl)C(=O)-}$ ,  $\text{-C(=O)CH(alkyl)-}$ ,  $\text{-CH=CH-}$ ,  
 $\text{-C(alkyl)=CH-}$ ,  $\text{-CH=C(alkyl)-}$ ,  $\text{-C(alkyl)=C(alkyl)-}$ ,  
 $\text{-C(=O)CH=CH-}$ ,  $\text{-P(Y}_{43}\text{)(Y}_{44}\text{-alkyl)-}$ , unsubstituted  
or substituted  $\text{-P(Y}_{43}\text{)(Y}_{44}\text{-aryl)}$  or arylene,  
 $\text{-Si'halogen)}_2\text{-}$ ,  $\text{-Si(alkyl)}_2\text{-}$ ,  $\text{-OC(=O)N(alkyl)-}$ ,  
 $\text{-OCH}_2\text{C(=O)N(alkyl)-}$ ,  $\text{-N(alkyl)CON(alkyl)-}$ ;  
 $\text{-OC(=O)NH-}$ ,  $\text{-NHCONH-}$ ,  $\text{-SO}_2\text{NHC(=O)NH-}$ ,  $\text{-NHC(=S)NH}$   
 $\text{-CH-CH-}$ ,  $\text{-C(alkyl)-CH-}$ ,  $\text{-CH-C(alkyl)-}$  or  
  
 $\text{-C(alkyl)-C(alkyl)-}$ ,

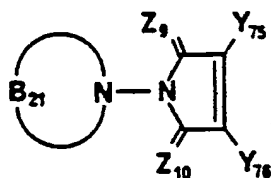
wherein h is a value of from 0 to 2 inclusive,  $\text{R}_{34}$  represents acyl, alkylsulfonyl, polyhaloalkyl,

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polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted or substituted aroyl or arylsulfonyl and  $Y_{43}$  and  $Y_{44}$  are independently O or S;

$Z_7$  and  $Z_8$  are independently O, S,  $C_1-C_8$  alkylidene, substituted or unsubstituted benzylidene, NH or  $NR'''$  wherein  $R'''$  is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

$Y_{73}$  and  $Y_{74}$  are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, aryl, polyhaloalkylsulfonyl, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy and polyhaloalkylsulfonyloxy;



(xxviii)

wherein:

$B_{21}$  represents  $-CH_2C(CH_3)_2SCH_2-$ ,  
 $-CH_2CH=C(CH_3)OCH_2-$ ,  
 $-CH_2CH_2SCH_2CH(CH_3)-$ ,  
 $-CH_2CH_2SCH_2CH_2-$ ,  $-CH_2SCH_2CO-$ ,  
 $-COCH_2C(CH_3)_2CH_2CO-$ ,  
 $-COCH_2CH(C_6H_5)CH_2CO-$ ,  
 $-CONH(C_6H_5)CH_2CH_2O-$ ,  $-COC(CH_3)_2NHCO-$ ,  
 $-CH_2CH_2N(C_6H_5)CH_2CH_2-$ ,  
 $-CH_2N(C_6H_5)CH_2CH_2-$ ,  
 $-CH_2CH_2CH(C_6H_5)CH_2CH_2-$ ,  
 $-CO(CH_2)_3CO-$ ,  $-CO(CH_2)_2CO-$ ,



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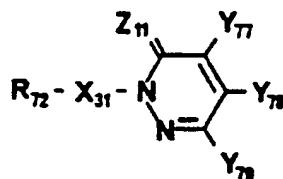
$-\text{COCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CO}-$ ,  $-\text{COCH}(\text{CH}_3)\text{CH}_2\text{CO}-$ ,  
 $-\text{COC}(\text{CH}_3)_2\text{CH}_2\text{CO}-$ ,  
 $-\text{COC}(\text{CH}_3)_2\text{C}(\text{CH}_3)_2\text{CO}-$ ,  $-\text{CO}(\text{CH}_2)_4\text{CO}-$ ,  
 $-\text{CO}(\text{CH}_2)_5\text{CO}-$ ,  $-\text{CO}(\text{CH}_2)_5\text{CH}_2-$ ,  
 $-\text{CO}(\text{CH}_2)_4\text{CH}_2-$ ,  $-\text{CO}(\text{CH}_2)_3\text{CH}_2-$ ,  
 $-\text{CO}(\text{CH}_2)_2\text{CH}_2-$ ,  $-\text{COCH}_2\text{SCH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{N}(\text{R}_{52})\text{CH}_2\text{CO}-$ ,  $-\text{COCH}_2\text{OCH}_2\text{CO}-$ ,  
 $-\text{COCH}_2\text{SCS}-$ ,  $-\text{COCH}=\text{CH}-\text{N}=\text{CH}-$ ,  
 $-\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2-\text{N}=\text{CH}-$  or  $-\text{CO}_2-\text{CH}_2\text{CH}_2-$

wherein  $\text{R}_{52}$  represents hydrogen, alkenyl;

unsubstituted or substituted aryl or alkaryl;

$\text{Z}_9$  and  $\text{Z}_{10}$  are independently O, S,  
 $\text{C}_1-\text{C}_8$  alkylidene, substituted or unsubstituted  
benzylidene, NH or  $\text{NR}'''$  wherein  $\text{R}'''$  is alkyl,  
aryl, aralkyl, alkenyl or alkynyl; and

$\text{Y}_{75}$  and  $\text{Y}_{76}$  are the same or different  
and represent hydrogen, halogen, alkyl, cyano,  
polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl,  
alkylthio, alkylsulfinyl, alkylsulfonyl, nitro,  
acyl, polyhaloalkylsulfonyl, amino, alkylamino,  
dialkylamino, acylamino, acyloxy, alkylsulfonyloxy,  
arylsulfonyloxy, alkenylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
phosphono or phosphino;

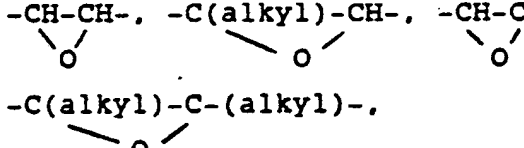


(xxix)

$\text{R}_{72}$  represents unsubstituted or  
substituted phenyl or 1- or 2-naphthyl;

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$X_{31}$  represents  $-OCH_2-$ ,  $-CH_2-$ , a covalent bond,  $-C(halogen)_2$ ,  $-C\equiv C-$ ,  $-OCH(alkyl)-$ ,  $-OC(alkyl)_2$ ,  $-CH(alkyl)CH(alkyl)-$ ,  $-CH(alkyl)-$ ,  $-C(alkyl)_2$ ,  $-OCH_2CH_2-$ ,  $-CH_2CH_2-$ ,  $SO$ ,  $-S-$ ,  $SO_2$ ,  $-CH_2S(O)_h-$ ,  $-CH(alkyl)S(O)_h-$ ,  $-S(O)_hCH_2-$ ,  $-CH(halogen)-$ ,  $-C(alkyl)(halogen)$ ,  $-CH(CN)-$ ,  $-C(alkyl)(CN)-$ , or  $-C(=O)-$ ,  $-CH(O-alkyl)-$ ,  $-CH_2C(=O)-$ ,  $-C(=O)CH_2$ ,  $-CH(alkyl)C(=O)-$ ,  $-C(=O)CH(alkyl)-$ ,  $-CH=CH-$ ,  $-C(alkyl)=CH-$ ,  $-CH=C(alkyl)-$ ,  $-C(alkyl)=C(alkyl)-$ ,  $-C(=O)CH=CH-$ , arylene,  $-Si(halogen)_2-$ ,  $-Si(alkyl)_2$ ,  $-CH-CH-$ ,  $-C(alkyl)-CH-$ ,  $-CH-C(alkyl)-$  or



$-C(alkyl)-C(alkyl)-$ .

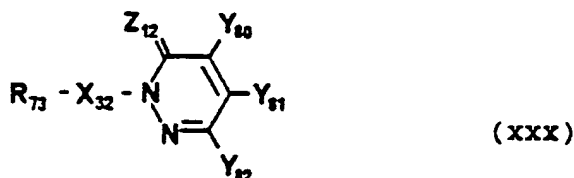
wherein  $h$  is a value of from 0 to 2 inclusive;

$Z_{11}$  represents  $O$ ,  $S$ ,  $C_1-C_8$  alkylidene, substituted or unsubstituted benzylidene,  $NH$  or  $NR'''$  wherein  $R'''$  is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

$Y_{77}$ ,  $Y_{78}$  and  $Y_{79}$  are the same or different and represent hydrogen, halogen, alkyl, hydroxy, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl, alkylamino, amino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, phosphono or phosphino, with the proviso that when  $Y_{77}$  is halogen and  $Y_{79}$  is hydrogen then  $Y_{78}$  cannot be amino, alkylamino, dialkylamino or acylamino and with the

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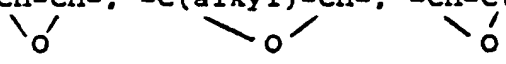

further proviso that when  $Y_{77}$  and  $Y_{78}$  are the same halogen then  $Y_{79}$  cannot be hydrogen or hydroxy;



$R_{73}$  represents an unsubstituted or substituted, unsaturated or saturated, aromatic or non-aromatic heterocyclic ring system selected from isoxazole, isothiazole, pyrazole, imidazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,4,-thiadiazole, 1,3,4-thiadiazole, oxazole, thiazole, benzopyrazole, benzimidazole, benzoxazole, benzothiazole, indole, pyrrole, furan, thiophene, benzofuran, benzothiophene, pyridine, pyrimidine, pyridazine, pyrazine, 1,3,5-triazine, 1,2,4-triazine, quinoline, isoquinoline, quinoxaline, phthalazine, benzopyridazine, benzopyrazine, carbazole, dibenzofuran, dibenzothiophene, benzoxazine, phthalimide, benzopyran, dibenzopyridine, pyridopyridine, pyrazolopyrimidine, tetrahydropyrimidinedione, piperidine, morpholine, tetrahydrofuran, tetrahydrothiophene, pyrrolidine, thiomorpholine, piperidine-2-one, piperidine-2,6-dione, 2,5-pyrrolidinedione, 3-morpholinone, 2-oxohexamethyleneimine, 2-oxotetramethyleneimine, 1-pyrazoline, 2-pyrazoline, pyrazolidine, 2-imidazolidinone, 2-imidazolidinethione, 2,4-imidazolidinedione, 1,2-oxathiolane, 1,3-oxathiolane, 1,3-oxathiane, 1,4-oxathiane,

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2(1H)-pyrazinone, 2H-pyran-2-one, 4H-pyran-4-one,  
 2H-pyran-2-thione, 4H-pyran-4-thione,  
 tetrahydropyran, tetrahydrothiopyran,  
 7-oxabicyclo[2.2.1]heptane,  
 7-azabicyclo[2.2.1]heptane, oxetane, coumarin,  
 1,3-dioxane, 1,4-dioxane or 1,3-dioxolane;

$X_{32}$  represents  $-OCH_2-$ ,  $-CH_2-$ , a  
 covalent bond,  $-C(\text{halogen})_2$ ,  $-C\equiv C-$ ,  $-OCH(\text{alkyl})-$ ,  
 $-OC(\text{alkyl})_2$ ,  $-CH(\text{alkyl})CH(\text{alkyl})-$ ,  $-CH(\text{alkyl})-$ ,  
 $-C(\text{alkyl})_2-$ ,  $-OCH_2CH_2-$ ,  $-CH_2CH_2-$ , SO,  $-S-$ ,  
 $SO_2$ ,  $-CH_2S(O)_h-$ ,  $-CH(\text{alkyl})S(O)_h-$ ,  
 $-S(O)_hCH_2-$ ,  $-CH(\text{halogen})-$ ,  $-C(\text{alkyl})(\text{halogen})-$ ,  
 $-CH(CN)-$ ,  $-C(\text{alkyl})(CN)-$ ,  $-C(=O)-$ ,  $-CH(O-alkyl)-$ ,  
 $-CH_2C(=O)-$ ,  $-C(=O)CH_2$ ,  $-CH(\text{alkyl})C(=O)-$ ,  
 $-C(=O)CH(\text{alkyl})-$ ,  $-CH=CH-$ ,  $-C(\text{alkyl})=CH-$ ,  
 $-CH=C(\text{alkyl})-$ ,  $-C(\text{alkyl})=C(\text{alkyl})-$ ,  $-C(=O)CH=CH-$ ,  
 arylene,  $-Si(\text{halogen})_2-$ ,  $-Si(\text{alkyl})_2$ ,  
 $-CH-CH-$ ,  $-C(\text{alkyl})-CH-$ ,  $-CH-C(\text{alkyl})-$  or  
  
 $-C(\text{alkyl})-C(\text{alkyl})-$ ,  


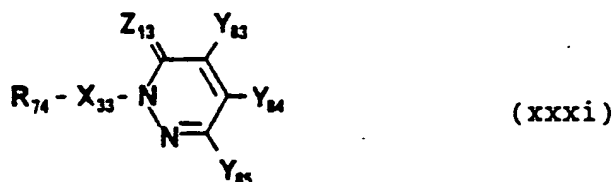
wherein h is a value of from 0 to 2 inclusive;

$Z_{12}$  represents O, S,  $C_1-C_8$   
 alkylidene, substituted or unsubstituted  
 benzyliidene, NH or  $NR'''$  wherein  $R'''$  is alkyl,  
 aryl, aralkyl, alkenyl or alkynyl; and

$Y_{80}$ ,  $Y_{81}$  and  $Y_{82}$  are the same or  
 different and represent hydrogen, halogen, alkyl,  
 hydroxy, cyano, polyhaloalkyl, alkoxy,  
 polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl,  
 alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl,  
 alkylamino, amino, dialkylamino, acylamino, acyloxy.

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alkylsulfonyloxy, arylsulfonyloxy,  
 alkenylsulfonyloxy, haloalkylsulfonyloxy,  
 polyhaloalkylsulfonyloxy, phosphono or phosphino;



$R_{74}$  represents unsubstituted or substituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkadienyl, cycloalkatrienyl, bicycloalkyl, bicycloalkenyl, bicycloalkadienyl, tricycloalkyl, tricycloalkenyl or tricycloalkadienyl;

$X_{33}$  represents  $-OCH_2-$ ,  $-CH_2-$ , a covalent bond,  $-C(halogen)_2$ ,  $-C\equiv C-$ ,  $-OCH(alkyl)-$ ,  $-OC(alkyl)_2$ ,  $-CH(alkyl)CH(alkyl)-$ ,  $-CH(alkyl)-$ ,  $-C(alkyl)_2-$ ,  $-OCH_2CH_2-$ ,  $-CH_2CH_2-$ ,  $SO$ ,  $-S-$ ,  $SO_2$ ,  $-CH_2S(O)_h-$ ,  $-CH(alkyl)S(O)_h-$ ,  $-S(O)_hCH_2-$ ,  $-CH(halogen)-$ ,  $-C(alkyl)(halogen)-$ ,  $-CH(CN)-$ ,  $-C(alkyl)(CN)-$ , or  $-C(=O)-$ ,  $-CH(O-alkyl)-$ ,  $-CH_2C(=O)-$ ,  $-C(=O)CH_2-$ ,  $-CH(alkyl)C(=O)-$ ,  $-C(=O)CH(alkyl)-$ ,  $-CH=CH-$ ,  $-C(alkyl)=CH-$ ,  $-CH=C(alkyl)-$ ,  $-C(alkyl)=C(alkyl)-$ ,  $-C(=O)CH=CH-$ , arylene,  $-Si(halogen)_2-$ ,  $-Si(alkyl)_2$ ,  $-CH-CH-$ ,  $-C(alkyl)-CH-$ ,  $-CH-C(alkyl)-$  or

$-C(alkyl)-C(alkyl)-$ ;

wherein  $h$  is a value of from 0 to 2 inclusive;

$Z_{13}$  represents O, S,  $C_1-C_8$  alkylidene, substituted or unsubstituted

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benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

Y<sub>83</sub>, Y<sub>84</sub> and Y<sub>85</sub> are the same or different and represent hydrogen, halogen, alkyl, hydroxy, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl, alkylamino, amino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy or polyhaloalkylsulfonyloxy; in which the permissible substituents for formulae (i) through (xxxi) above are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,

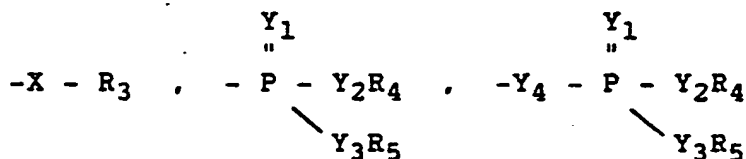
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polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato,

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isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

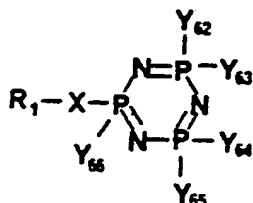
$-X, = X, -X = R_3, = X-R_3,$



or



$R_1 - X - R_{36} \quad (xxxii)$



(xxxiii)

wherein:

$Y_{62}, Y_{63}, Y_{64}, Y_{65}$  and  $Y_{66}$  are  
the same or different and are halogen;

$R_1$  is a substituted or unsubstituted,  
carbocyclic or heterocyclic ring system selected  
from a monocyclic aromatic or nonaromatic ring  
system, a bicyclic aromatic or nonaromatic ring



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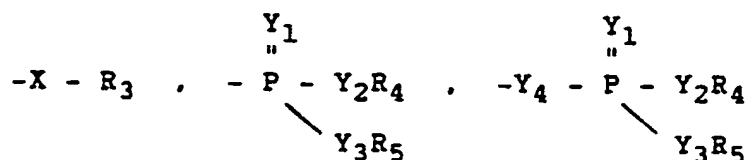
system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy,

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polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, or a hydroxy  
group condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

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$-X, = X, -X = R_3, = X-R_3.$



or



$R_1$  is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl,

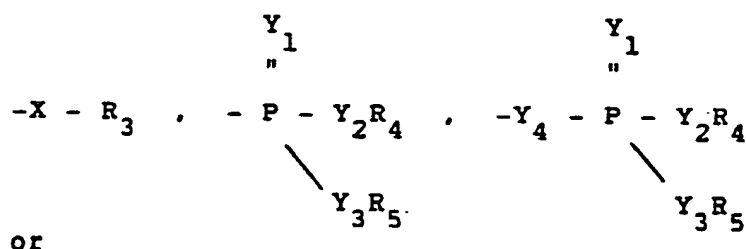
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alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy.

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haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



X is a covalent single bond or double bond,  
 a substituted or unsubstituted heteroatom or  
 substituted carbon atom, or a substituted or  
 unsubstituted, branched or straight chain containing  
 two or more carbon atoms or heteroatoms in any  
 combination in which the permissible substituents  
 are the same or different and are one or more

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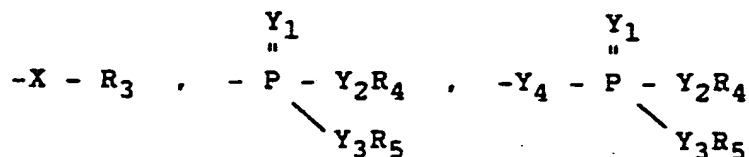
hydrogen, halogen, alkylcarbonyl,  
alkylcarbonylalkyl, alkoxycarbonylalkyl,  
alkoxycarbonylalkylthio, polyhaloalkenylthio,  
thiocyano, propargylthio, hydroxyimino, alkoxyimino,  
trialkylsilyloxy, aryldialkylsilyloxy,  
triarylsilyloxy, formamidino, alkylsulfamido,  
dialkylsulfamido, alkoxysulfonyl,  
polyhaloalkoxysulfonyl, hydroxy, amino,  
aminocarbonyl, alkylaminocarbonyl,  
dialkylaminocarbonyl, aminothiocarbonyl,  
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,  
nitro, cyano, hydroxycarbonyl and derivative salts,  
formamido, alkyl, alkoxy, polyhaloalkyl,  
polyhaloalkoxy, alkoxycarbonyl, substituted amino in  
which the permissible substituents are the same or  
different and are one or two propargyl, alkoxyalkyl,  
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or  
polyhaloalkenyl; alkylthio, polyhaloalkylthio,  
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,  
polyhaloalkylsulfonyl, alkylsulfonylamino,  
alkylcarbonylamino, polyhaloalkylsulfonylamino,  
polyhaloalkylcarbonylamino, trialkylsilyl,  
aryldialkylsilyl, triarylsilyl, sulfonic acid and  
derivative salts, phosphonic acid and derivative  
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,  
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,  
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,  
polyhaloalkynyl, polyhaloalkynyloxy,  
polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted

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or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxy sulfonyl, aryloxy sulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxy carbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxy carbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl, dialkoxyphosphino, hydroxyamino, alkoxyamino, aryloxyamino, aryloxyimino, oxo, thiono, alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy, alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>,

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or



$R_{36}$  is a substituted or unsubstituted, asymmetrical heterocyclic ring system having at least three nitrogen atoms which is selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryl dialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or



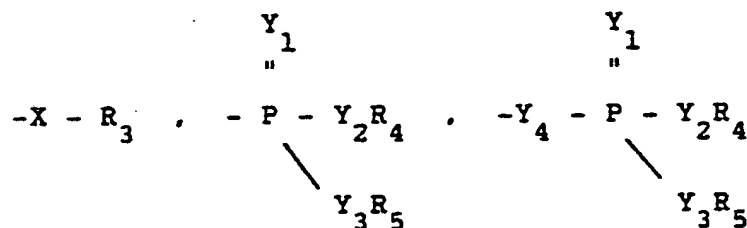
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different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,

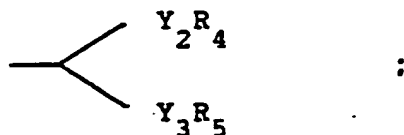
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alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



wherein:

$R_3$  is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring

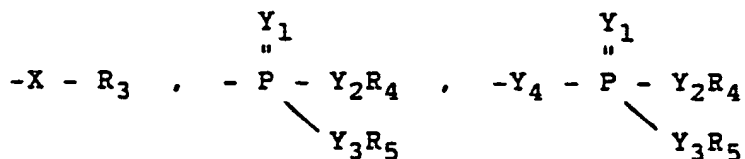
- 781 -

system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy,

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polyfluoroalkanol, cyanoalkylamino,  
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,  
alkoxyiminomethyl, unsubstituted or substituted  
aryloxyiminomethyl, hydrazonomethyl, unsubstituted  
or substituted arylhydrazonomethyl, a hydroxy group  
condensed with a mono-, di- or polysaccharide,  
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,  
aryloxy, aralkoxy, arylthio, aralkylthio,  
alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
aminosulfonyl, alkylaminosulfonyl,  
dialkylaminosulfonyl, arylaminosulfonyl,  
carboxyalkoxy, carboxyalkylthio,  
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
alkenylsulfonyloxy, arylsulfonyloxy,  
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
aroylamino, haloacylamino, alkoxycarbonyloxy,  
arylsulfonylamino, aminocarbonyloxy, cyanato,  
isocyanato, isothiocyano, cycloalkylamino,  
trialkylammonium, arylamino, aryl(alkyl)amino,  
aralkylamino, alkoxyalkylphosphinyl,  
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
dialkoxyphosphino, hydroxyamino, alkoxyamino,  
aryloxyamino, aryloxyimino, oxo, thiono,  
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

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$$-X, = X, -X = R_3, = X-R_3,$$


or



$R_3$  is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl,

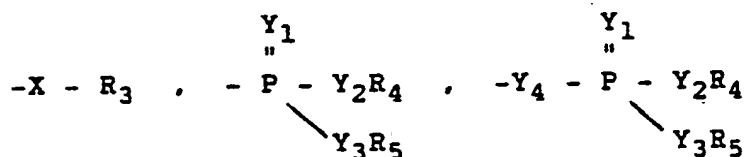
- 784 -

alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy,

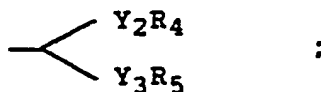
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haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxy-carbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



$Y_1$  and  $Y_4$  are independently oxygen or sulfur;

$Y_2$  and  $Y_3$  are independently oxygen, sulfur, amino or a covalent bond; and

$R_4$  and  $R_5$  are independently hydrogen or substituted or unsubstituted alkyl, polyhaloalkyl, phenyl or benzyl in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy-carbonylalkyl, alkoxy-carbonylalkylthio, polyhaloalkenylthio,

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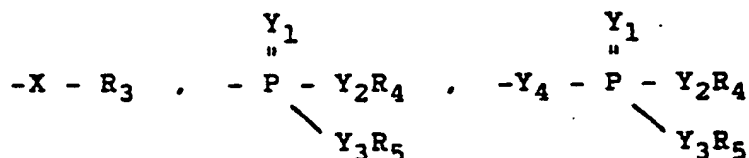
thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,



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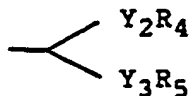
aryloxy, aralkoxy, arylthio, aralkylthio,  
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,  
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,  
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,  
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,  
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,  
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,  
 aminosulfonyl, alkylaminosulfonyl,  
 dialkylaminosulfonyl, arylaminosulfonyl,  
 carboxyalkoxy, carboxyalkylthio,  
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,  
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,  
 alkenylsulfonyloxy, arylsulfonyloxy,  
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,  
 aroylamino, haloacylamino, alkoxycarbonyloxy,  
 arylsulfonylamino, aminocarbonyloxy, cyanato,  
 isocyanato, isothiocyano, cycloalkylamino,  
 trialkylammonium, arylamino, aryl(alkyl)amino,  
 aralkylamino, alkoxyalkylphosphinyl,  
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,  
 dialkoxyphosphino, hydroxyamino, alkoxyamino,  
 aryloxyamino, aryloxyimino, oxo, thiono,  
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,  
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R<sub>3</sub>, = X-R<sub>3</sub>,



or

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106. A composition for reducing moisture loss from plants comprising an acceptable carrier and an effective amount, sufficient to reduce moisture loss from plants without substantially inhibiting plant photosynthetic electron transport, of a compound of claim 105.

107. A composition for increasing crop yield comprising an acceptable carrier and an effective amount sufficient to increase crop yield without substantially inhibiting plant photosynthetic electron transport, of a compound of claim 105.

108. The method of claim 1 in which the compound is used in combination with one or more other biologically active compounds.

109. The method of claim 53 in which the compound is used in combination with one or more other biologically active compounds.

110. A method for reducing moisture loss from soil having plants or crops planted therein which comprises applying to the plant surface or crop an effective amount, sufficient to reduce soil moisture loss without substantially inhibiting plant photosynthetic electron transport, of a compound having the formula

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$$R_1 - X - R_2$$

wherein  $R_1$ , X and  $R_2$  are as defined in claim 1.